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**International Infantry & Joint Services  
Small Arms Systems Section Symposium, Exhibition & Firing Demonstration**

**13-16 May 2002**

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[Rapidity With Accuracy: Modernizing the U.S. Army Service Rifle in the Gilded Age 1880-1903](#) by Stephen C. Small, JSSAP

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[Sensors for Small Arms Munitions](#) by Tomas Cincotta, U.S. Army CECOM RDEC NVESD

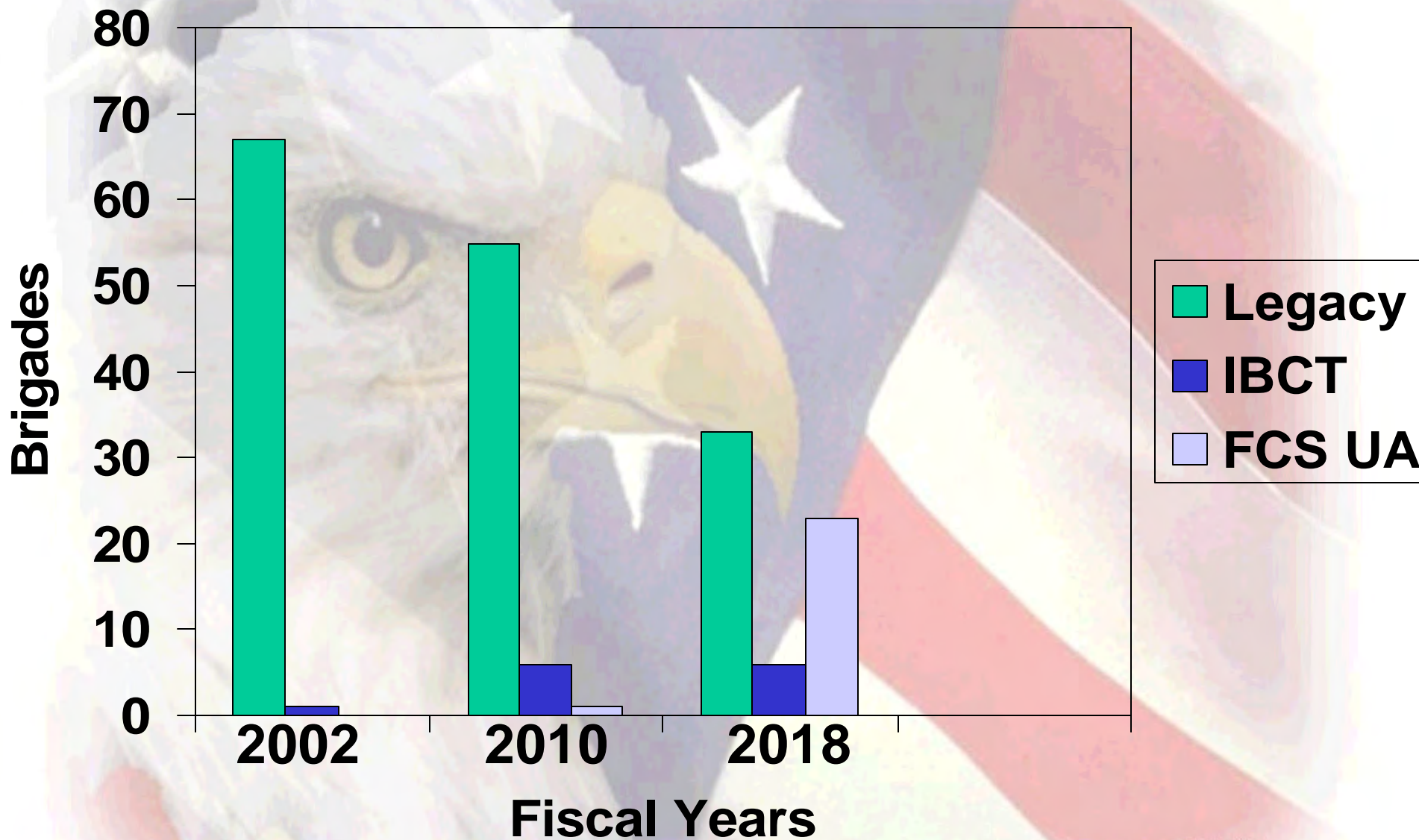
[Multiple Magazine Holder](#) by Angelo Mancini, SARCO, Inc.

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# **The Infantry Force**

# ***INFANTRY UNIT PROJECTIONS***





# Enduring Qualities of the Infantry

- Dominates the close, personal fight
- Seize, secure, and retain key terrain
- Maximum use of stealth and surprise
- Infantry “warrior” ethos

Today / Legacy



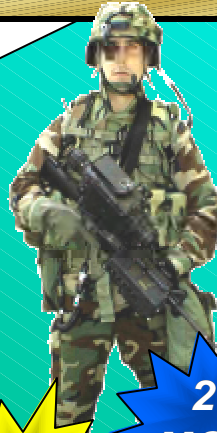
4  
TOEs

4  
MOS

Enabled  
by:



Tomorrow / Interim



3  
TOEs

2  
MOS

Enabled  
by:



Future / Objective

Enabled  
by:

1-2  
TOEs

1-2  
MOS



- Executes decentralized simultaneous attacks
- Primarily at night or limited visibility
- Flexible and resilient organizations
- Enhance full spectrum operations

# Areas of Operation

## URBAN

- Manpower Intensive Operations
- Limits Platform-based, System Advantages

**Primarily Mounted Actions  
(Rolling, Mixed Terrain)**

**Mounted Actions Supported by  
Dismounted Actions (Defiles,  
Danger Areas, Obstacles)**

**Dismounted Actions  
Supported by Mounted  
Actions (Mixed &  
Complex Terrain)**

**Primarily  
Dismounted  
Actions**

## Open, Rolling - Arid

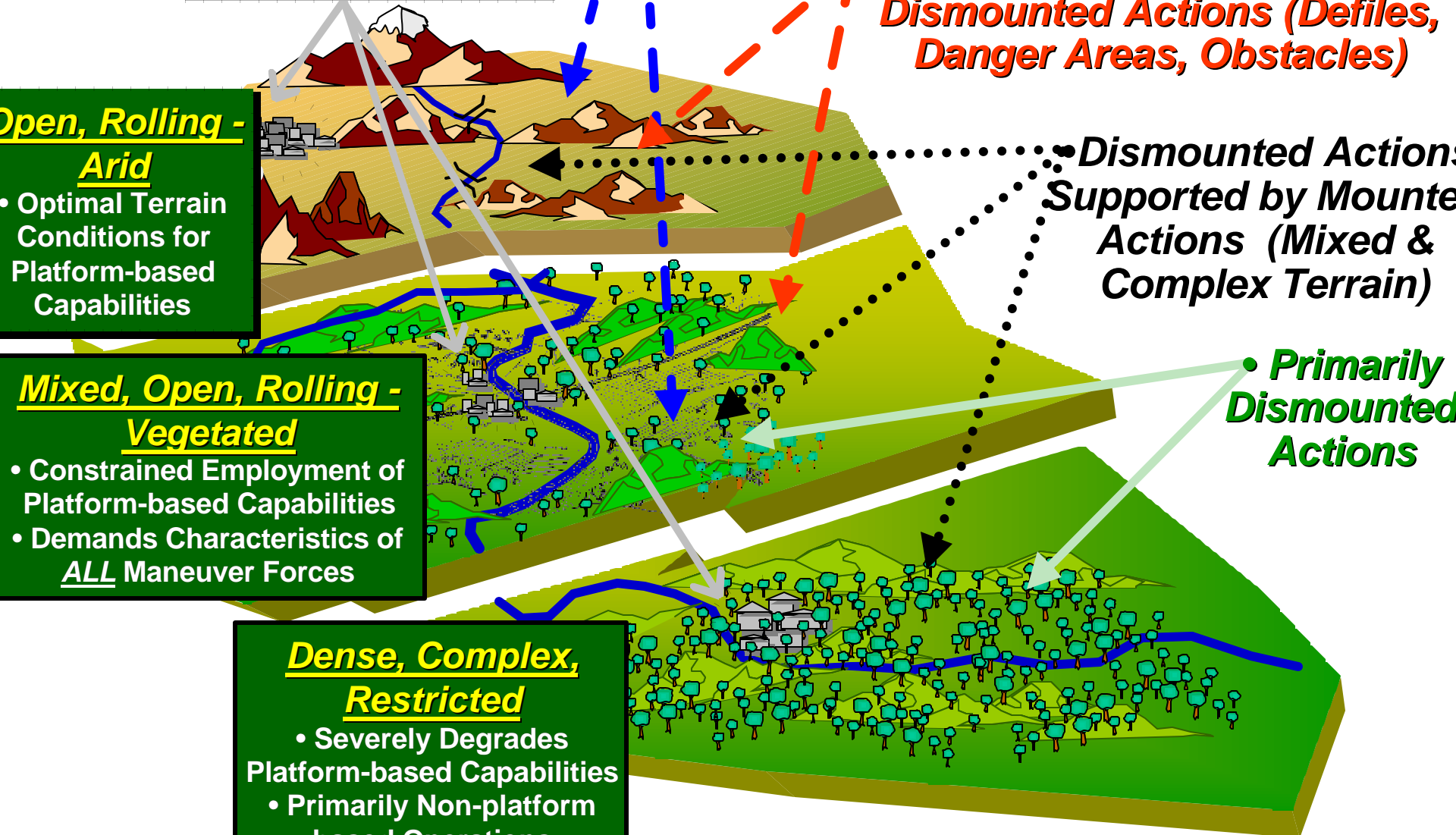
- Optimal Terrain Conditions for Platform-based Capabilities

## Mixed, Open, Rolling - Vegetated

- Constrained Employment of Platform-based Capabilities
- Demands Characteristics of ALL Maneuver Forces

## Dense, Complex, Restricted

- Severely Degrades Platform-based Capabilities
- Primarily Non-platform Local Operations



# ***PRESSING REQUIREMENTS***

**Synchronize Requirements between Current, Interim,  
and Objective forces**

**Reduction in Soldiers Load**

- **Weight Reduction**
- **Improved Power Management**

**Increasing the Individual Soldier's Lethality**

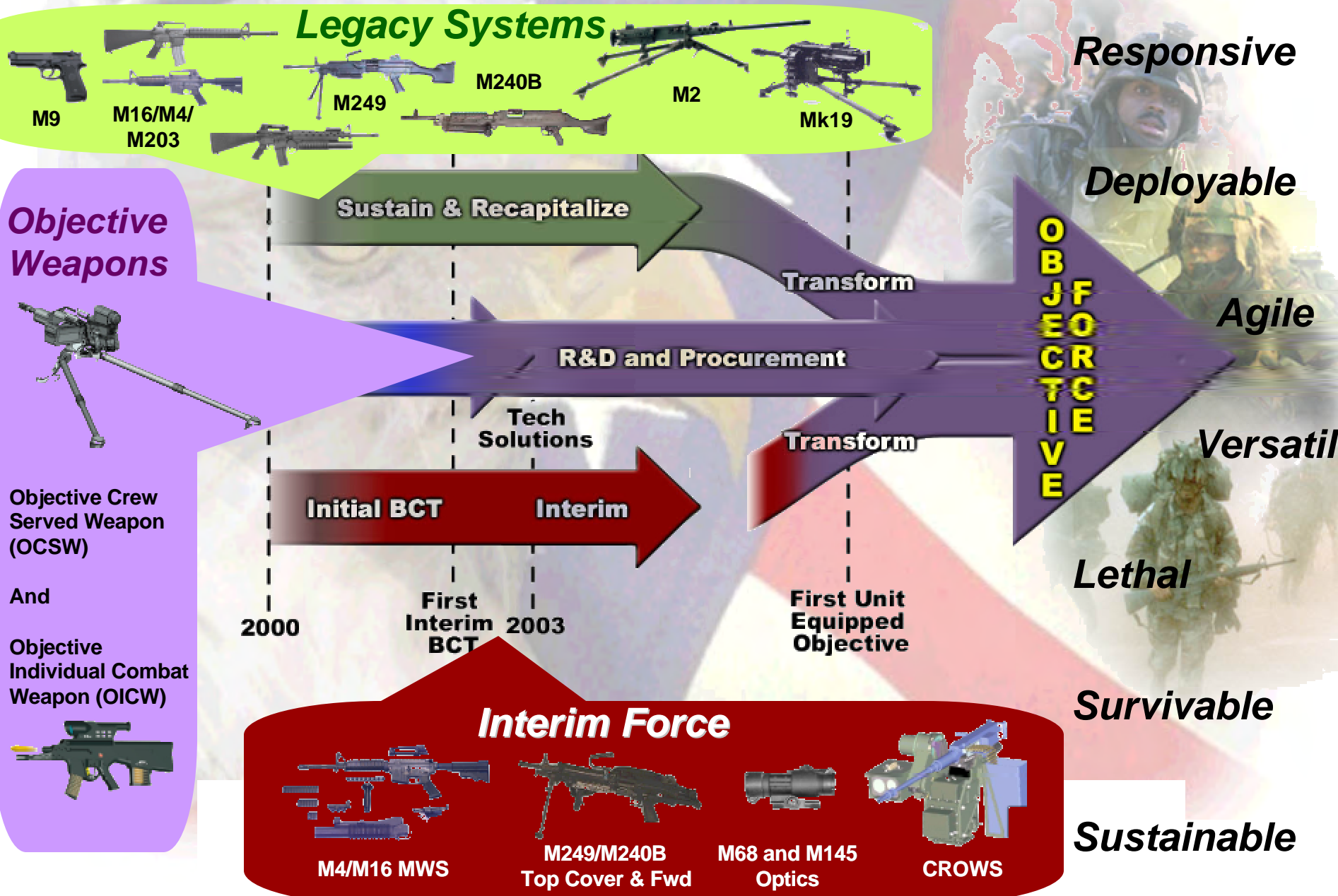
**Improvements in C2 and Situational Awareness**

**Capabilities for the Infantry**

**Enabling Precision Engagement**



# Small Arms Transformation



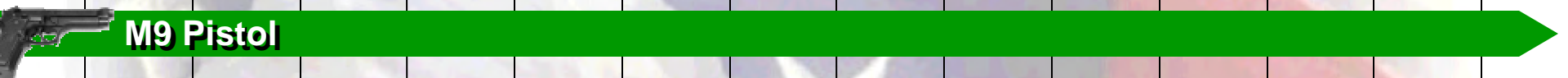
# Individual Small Arms

## Existing Systems

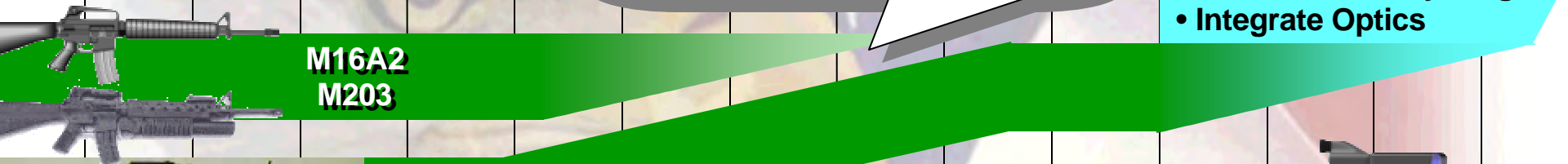
## Emerging Systems

## Objective Systems

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------



**M9 Pistol**



**M16A2  
M203**



**MWS  
M4 / M16A4**

Modular Weapon System replaces aging systems as OICW fielding progresses

**BLOCK 1**

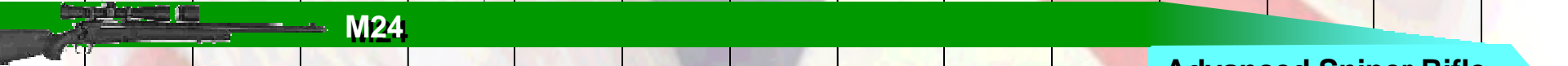
**BLOCK 2**

**BLOCK 3**

**OICW**



**M107**



**M24**

### Advanced Combat Rifle

- Reduce weight
- Maintain lethality/range
- Integrate Optics

### Advanced Sniper Rifle

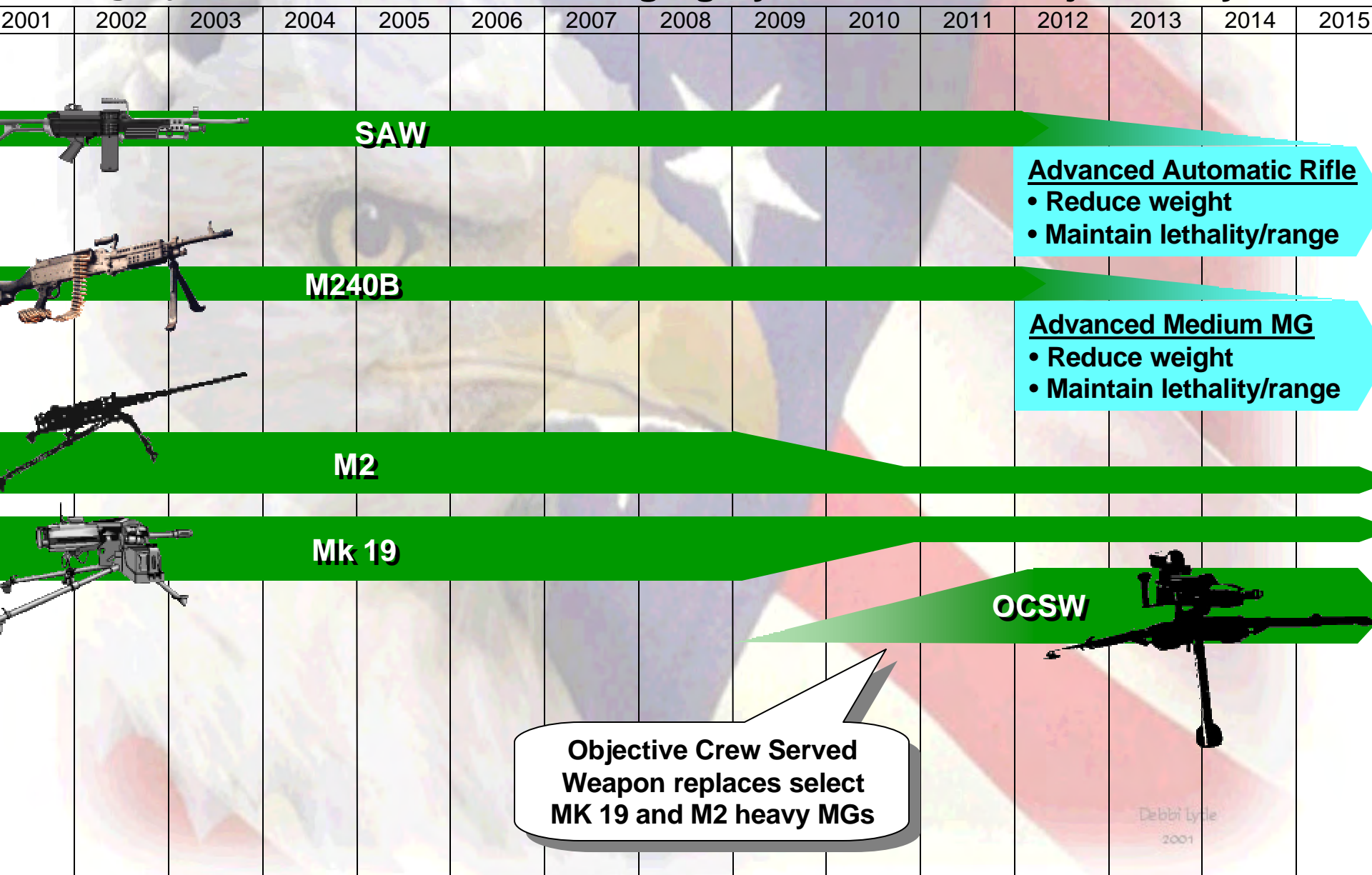
- Reduce weight
- Maintain lethality/range
- Increased Rate of Fire

# Automatic Small Arms

## Existing Systems

## Emerging Systems

## Objective Systems







# 2002 International Infantry and Joint Services Small Arms Symposium and Exhibition

## Mortar Overview



**LTC Larry Hollingsworth**  
**PM Mortars**

*PEO Ammunition*

# Task and Purpose



Provide **Government, Industry**, and  
**International Participants** an  
Azimuth Check to Ensure  
**Synchronization of Operational  
Requirements and Technologies**  
Between Industry, User, and Materiel  
Developer

# Bottom Line



Capitalize



**We are a Critical Lethality  
Provider to the Army's  
Transformation METL**



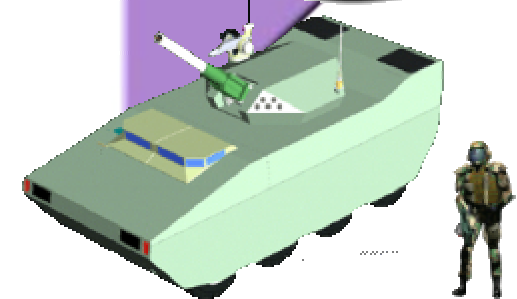
**BCT**

**Interim**

**First  
Interim 2003  
BCT**



**First Unit  
Equipped  
Objective**





# A Little Perspective



*The More things Change,  
The More They Remain the Same...*

- 12 - 15KM
- 1 Meter CEP
- Infrared Illumination
- DPICM
- Precision Munitions
- Digital Ballistic Computation
- Hip Pocket Fire Support
- Fight the Close Fight
- Shape the Area of Operation
- Suppress
- Neutralize
- Destroy



*“K Comp’ny artillery commander speakin’.”*



# Mission

Serve as **Life Cycle Manager** for development, acquisition, production, fielding, sustainment, and product improvement of the full range of **mortar platforms, fire control systems, and ammunition** integrated across **Legacy, Interim and Objective Forces**.

*...Product Manager, Mortar Systems Charter June 2001*

# Vision

Develop Systems that serve as the Maneuver Commander's Responsive, Lethal and Accurate Indirect Fire Weapon of Choice for Engaging Targets in his Area of Operation.



# How We Support Army Transformation



## LEGACY FORCE

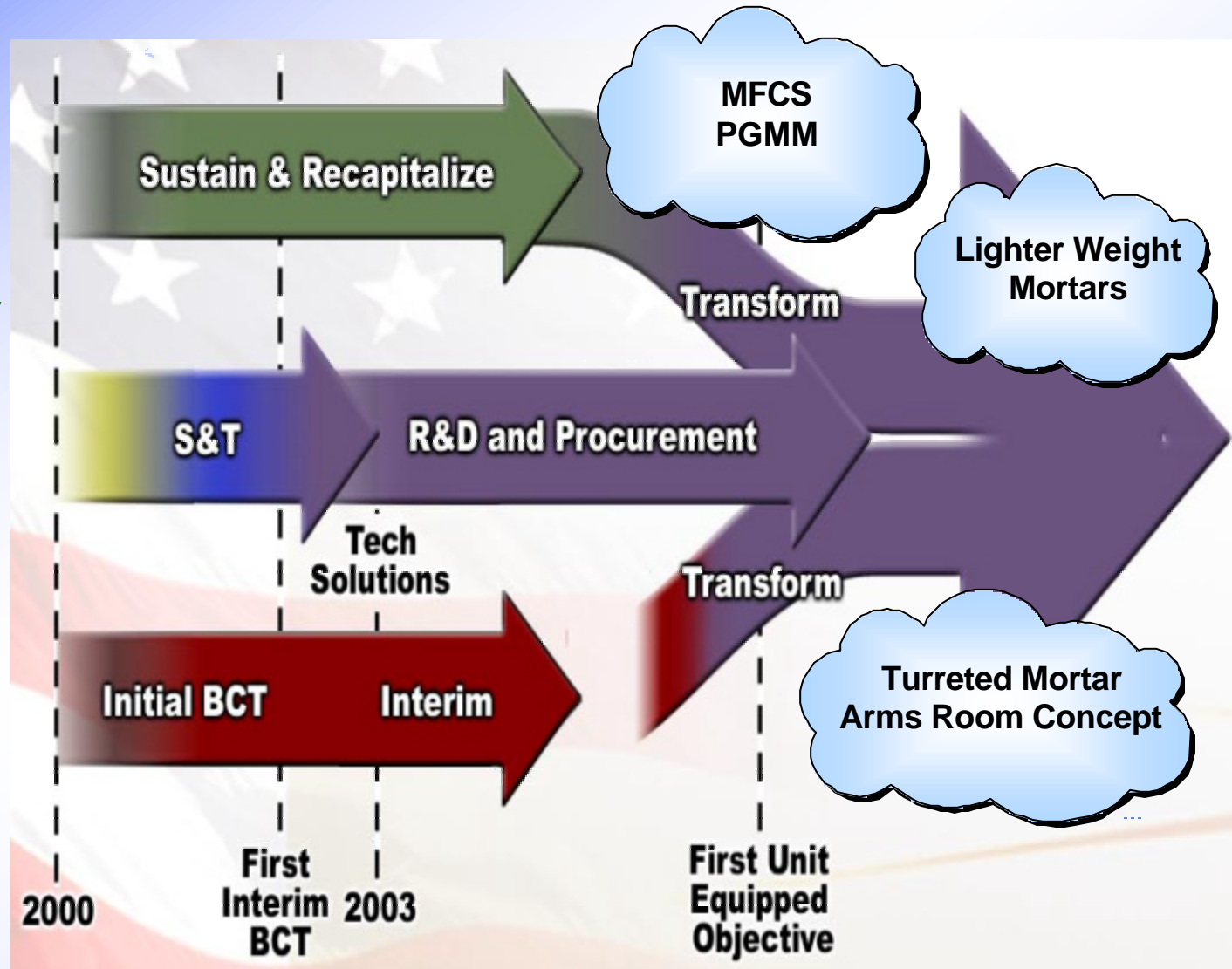
Fire Control  
Battalion Mortar System  
Mortar Fuze Development  
Precision Guided Mortar Munition  
60/81/120mm Ammo Family

## OBJECTIVE FORCE

Fire Control  
Precision Guided Mortar Munition  
60/81/120mm Ammo Family  
Turreted Mortar

## INTERIM FORCE

Fire Control  
Battalion Mortar System  
Mortar Fuze Development  
60/81/120mm Ammo Family  
Precision Guided Mortar Munition  
Support to PM BCT



# PEO Ammo Organization



ASAALT DASCs

☆☆  
**PEO  
Ammunition  
COL(P) Paul Izzo**

Director – Business  
Director – Programs  
Director – Industrial Base

🏆  
**Deputy for  
Research,  
Development &  
Production**

🏆 **General Manager  
Ammunition**

Close Combat  
Systems

✈️  
**PM  
Combat Ammunition  
Systems**

✈️  
Maneuver Ammo  
System Direct Fire

✈️  
Joint Services

Organic Base  
Operations  
(Ammo Plants)

Demo, Mines,  
MICLIC & Grenades

PM Mortars

Large Caliber

DEMIL

Excalibur

Medium & Small  
Caliber

# PM CAS Organization



**Senior Engineer and  
Technical Manager**  
William DeMassi

**Program Manager**  
**COL Nathaniel Sledge**  
  
**DPM**  
**Patrick Serao**

**International  
Programs and  
Life Cycle  
Management**  
George Batchis

**155mm Recap  
Management**  
Steve Hromnak

**Business  
Management**  
Joseph Gormley

**PM Excalibur**  
LTC Jeff Wilson

**PM Mortars**  
LTC Larry Hollingsworth

**Production  
Engineering and  
Product  
Assurance**  
Armando Herrera

# PM Mortars Organization



**Product Manager**  
**LTC Larry Hollingsworth**  
**(973) 724-7073**  
**Hollings@pica.army.mil**

**Deputy Product Manager**  
**Patti Felth GS-15**  
**(973) 724-6059**  
**Felth@pica.army.mil**

**Business  
Management**  
**Cynthia Alesandro GS-14**  
**(973) 724-4209**  
**Calesa@pica.army.mil**

**Ammunition**  
**John Slivovsky GS-14**  
**(973) 724-3665**  
**Slivovsk@pica.army.mil**

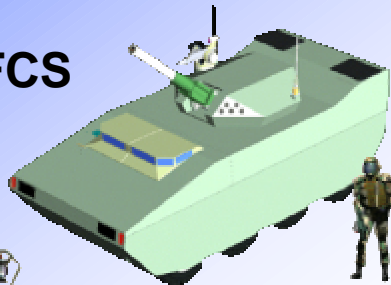
**Weapons &  
Fire Control**  
**Ed Lewis GS-14**  
**(973) 724-4995**  
**Elewis@pica.army.mil**

**Advanced  
Systems**  
**Pete Burke GS-14**  
**(973) 724-5802**  
**Pburke@pica.army.mil**

# Who We Are



FCS



81MM



60MM



120MM



120MM Heavy



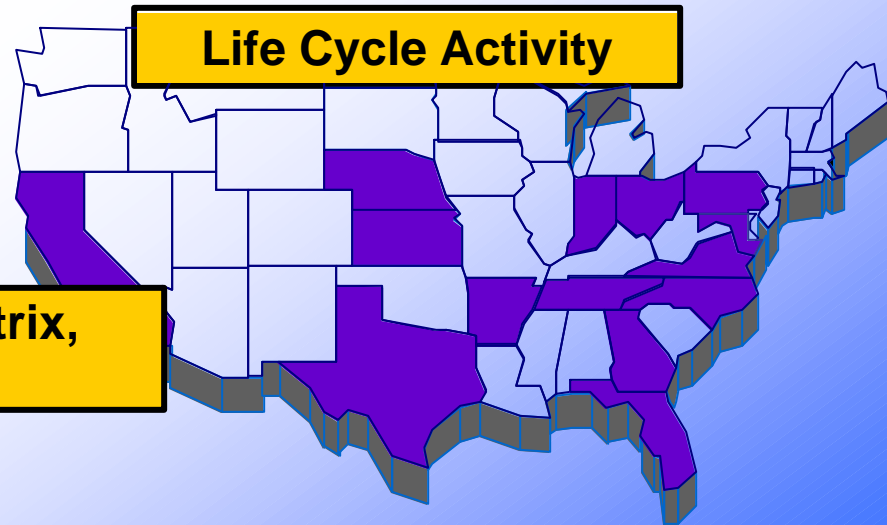
120MM BCT



Munitions

Fire Control

Life Cycle Activity



Personnel: 30 Core, 6 Matrix,  
10 Contract Support

49 Open Contracts

21 BLIN

POM 02-07 \$ 1.17B

WTCV  
2%

RDTE  
13%

OPA-2  
15%

PAA  
70%



Germany



Switzerland



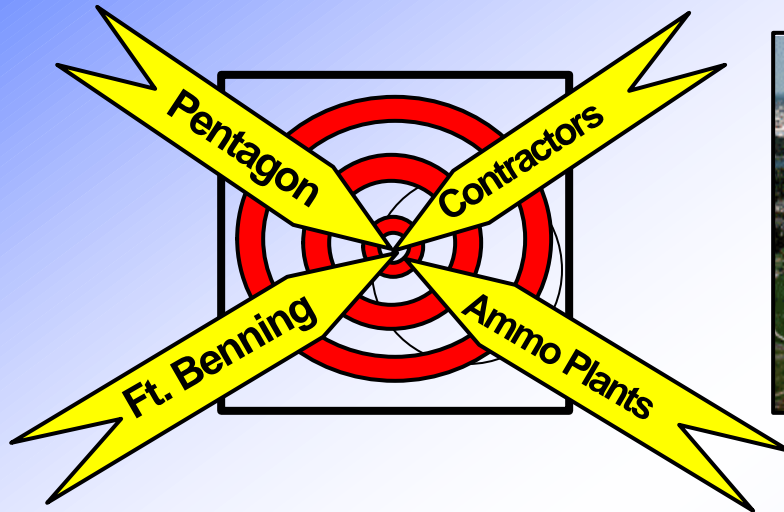
Canada



# How We Operate



*We go “EYEBALL TO EYEBALL” with the Customer, the Contractor and the Building*

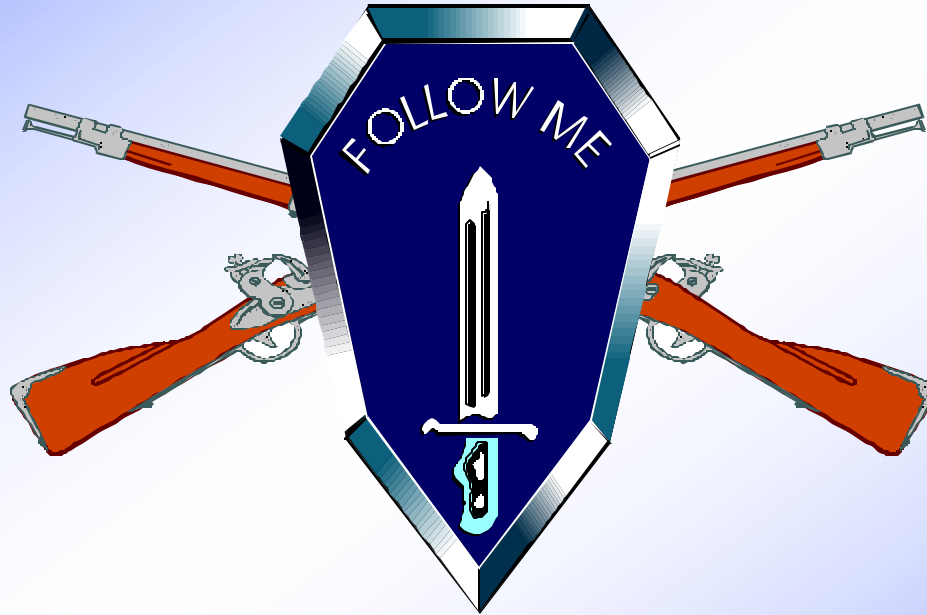


- ❖ Work closely with our ARDEC
- ❖ Structured IPTs (over 30 IPTs)
- ❖ Quarterly Reviews (ALL IPT Members Present)
- ❖ Monthly Procurement Reviews (Planners and Executors)

- ❖ Manage Product Life Cycles
- ❖ Plan / manage Product Improvements
- ❖ We Integrate Platforms /HW / SW / Ammo

**Use PM Mortars as  
your Entry Point**

# Our Customers



**United States Army Infantry Center  
Directorate of Combat Development  
Firepower Division**

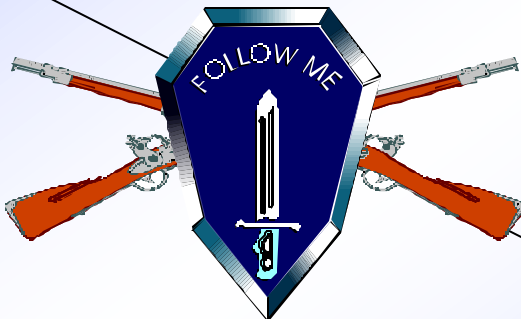


**Foreign Military Sales**

# USAIC Priorities



	SYSTEM/ PROGRAM		SYSTEM/ PROGRAM
1	(LW) Land Warrior	26	Small Arms Improvement Program
2	Line-of-Sight Anti-Tank (LOSAT)	27	Infrared Aiming Light (PEQ-2)
3	TOW Fire & Forget	28	M 4/M 16 Modular Weapon System (MWS)
4	Javelin	29	120mm DPICM Munition
5	Compact Kinetic Energy Missile (CKEM)	30	Shortstop
6	Improved Target Acquisition System (ITAS)	31	Multi-function Laser (LAM)
7	Modular Body Armor/Interceptor Body Armor	32	Tactical Unmanned Vehicle - Medium (TUV-M)
8	Objective Individual Combat Weapon (OICW)	33	M 2 Bradley Recapitalization
9	Future Combat System (FCS)	34	M-240B Machine Gun Improvements
10	Thermal Weapon System (TWS)	35	Bradley Reactive Armor Tiles
11	Interim Armored Vehicle (IAV) - ICV, ATGM, MG	36	Long Range Sniper Night Vision
12	Joint Common Missile (JCM)	37	Multi-Purpose Individual
13	Night Vision Goggles (PVS-7/14/ENVG)	38	Lightweight Video Recording
14	Precision Guided Mortar Munition	39	M-4 Carbine
15	Combat Identification for the dismounted Soldier	40	MK-19 Grenade Launcher
16	Objective Crew Served Weapon (OCSW)	41	M-107 Long Range Sniper
17	M2A3 Bradley	42	Bradley Embedded Thermal
18	Mortar Fire Control System (MFCS) XM95	43	Manportable Robotic
19	Integrated rmy Active Protection System	44	Enhanced Target Location
20	Modular Load System (MLS) / (MOLLE)	45	Lightweight Utility Module
21	Enroute Mission Planning Rehearsal System	46	Non-lethal Equipment
22	Mortar Ballistic Computer XM31	47	Platoon Early Warning
23	Rifle Launched Entry Munition (RLEM)	48	M-113A3 FOV Upgrade
24	Light Digital TOC (LD-TOC)	49	HTI 2nd Generation F
25	Mortar IR Illumination Cartridge	50	Driver Vision Enhance



14

Precision Guided Mortar Munition

18

Mortar Fire Control System (MFCS) XM95

22

Mortar Ballistic Computer XM31

25

Mortar IR Illumination Cartridge

29

120mm DPICM Munition

**BOS: Maneuver  
Precision Engagement**

**PEG: Equipment**



# DCD Firepower Priorities



**Mortar Ballistic Computer (Dismounted)**

**Mortar Fire Control System**

**Precision Guided Mortar Munition**

**IR Illumination**

**120mm DPICM Munition**

**Arms Room Concept**

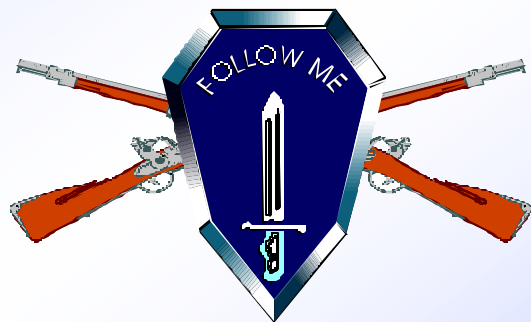
**Lightweight Mortars Working Group**

**81mm Training Insert for 120mm Mortar**

**Ammunition**

**Turreted Mortar**

**The Objective Force...**



**Responsive**

**Deployable**

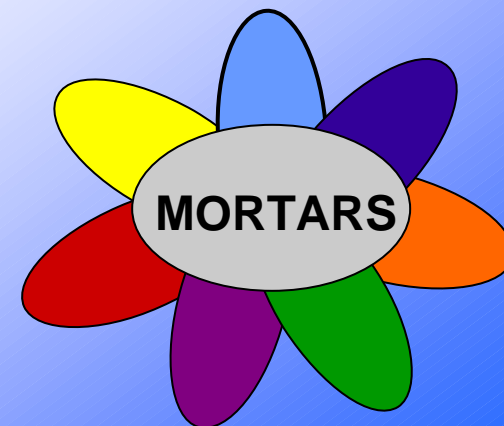
**Agile**

**Versatile**

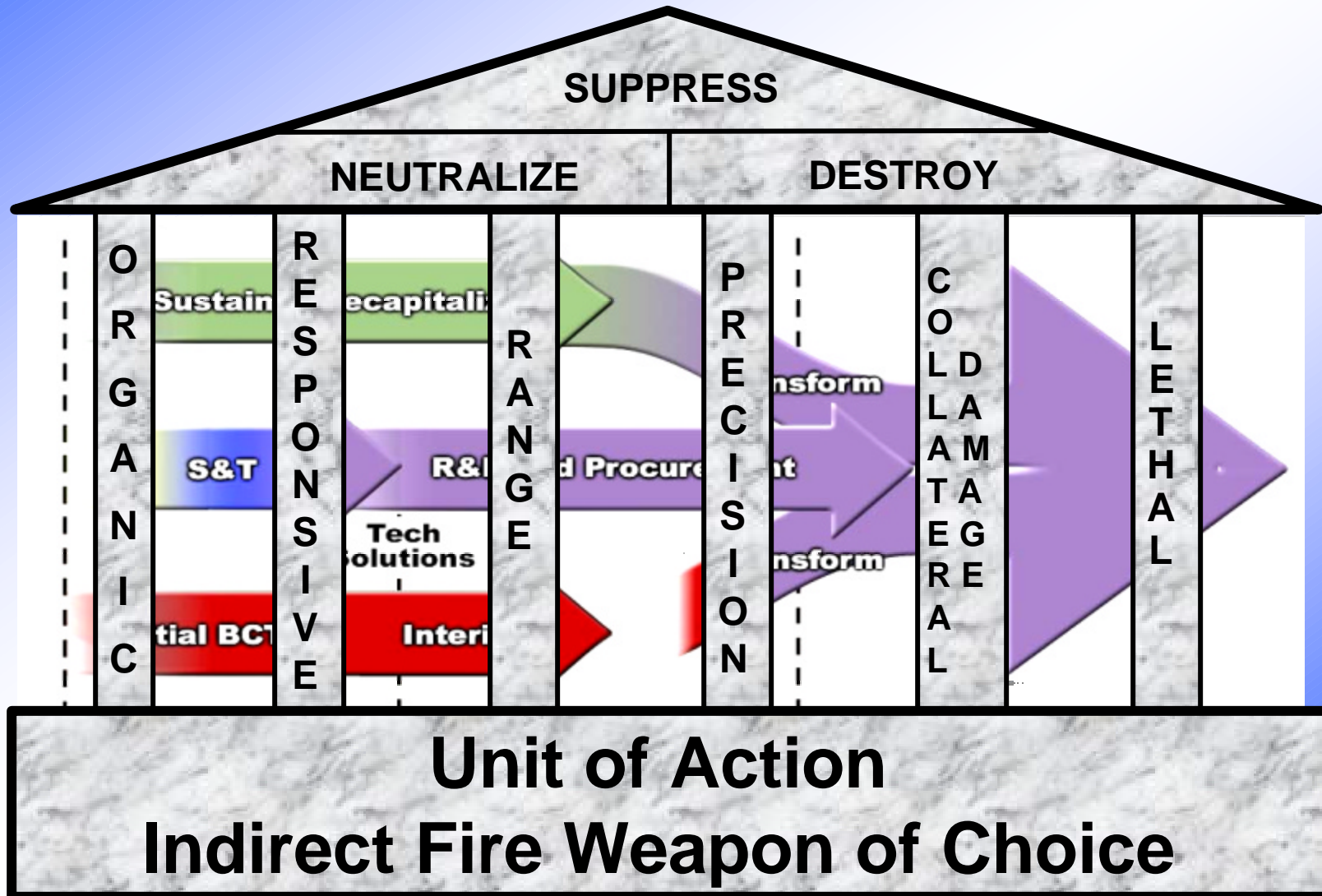
**Lethal**

**Survivable**

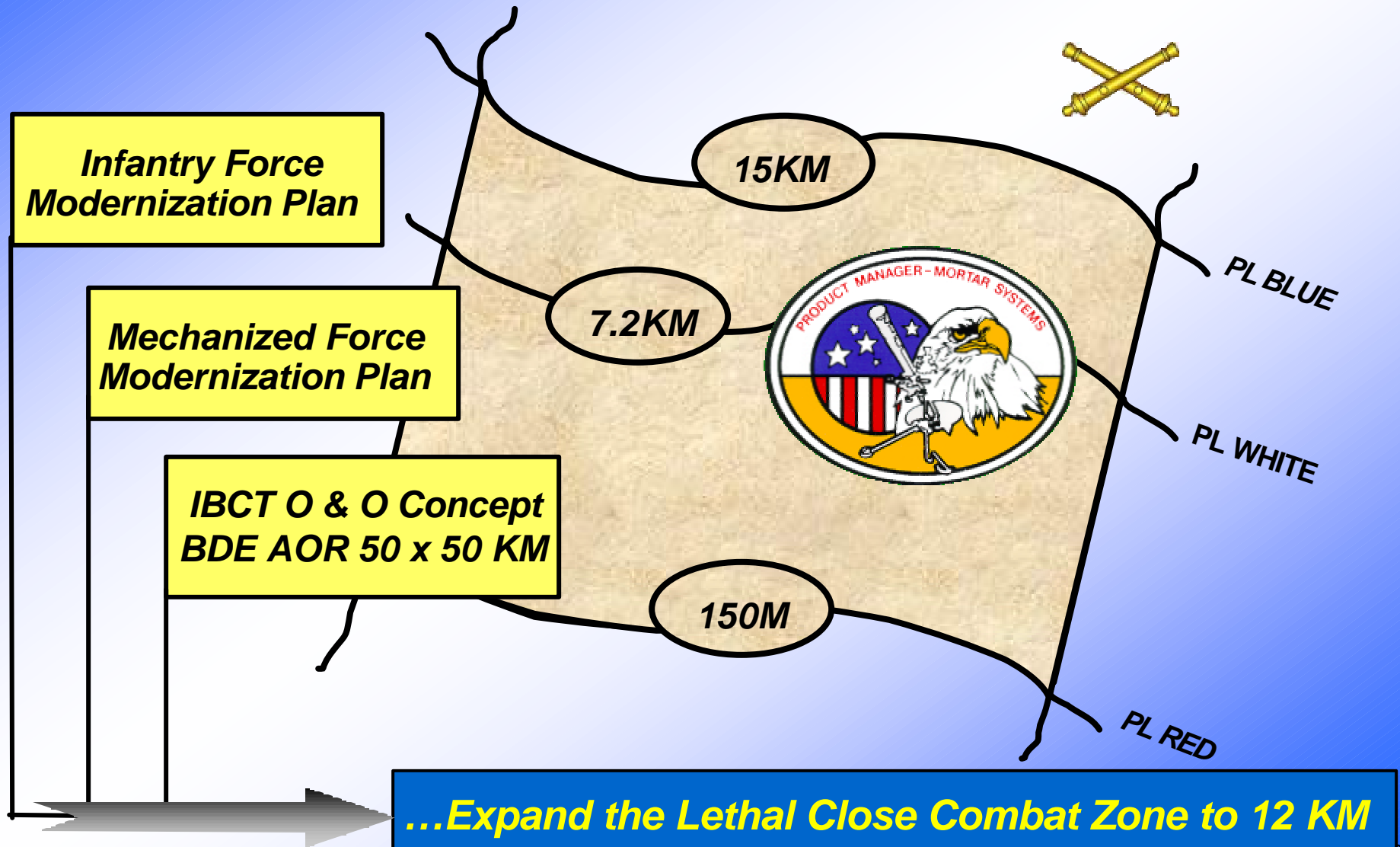
**Sustainable**



# How We Fit In...



# Where We Fit In...

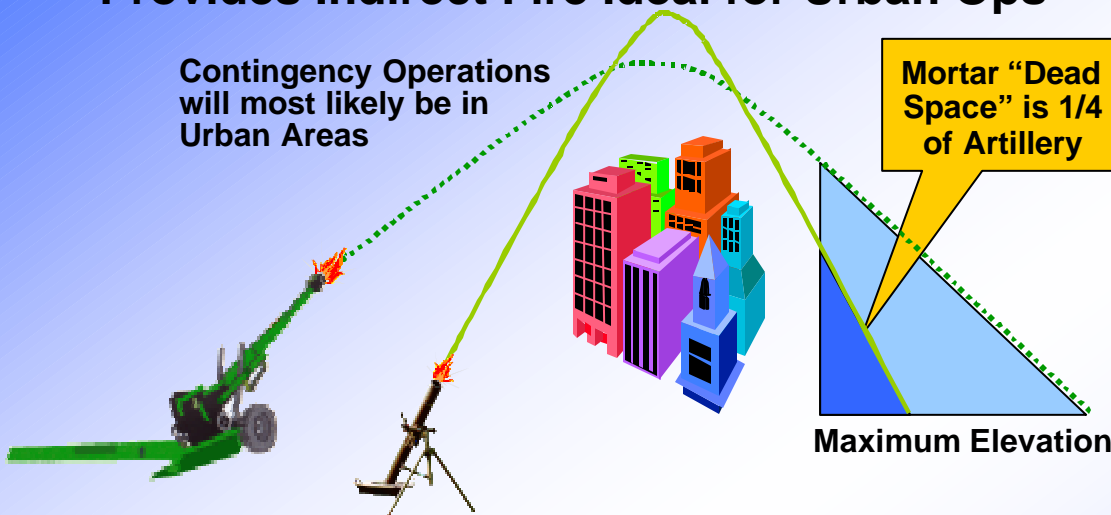


# Why We Fit In...



## Provides Indirect Fire Ideal for Urban Ops

Contingency Operations  
will most likely be in  
Urban Areas



## Mortar Advances Reduce Logistics Burden

C-17 Loads Required for  
Mortar Ammunition

(55 Short Tons/Flight)



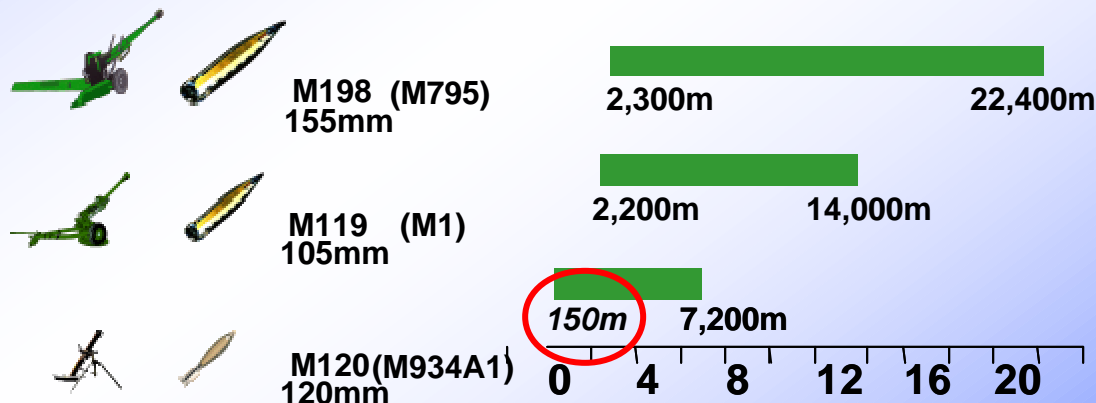
Base Case: 16 C-17s

Vs.



Conventional & PGMM: 3

## Provides Short Minimum Range for Close Fight





# Current Unit Distribution



**12 120mm Mortars in  
the Heavy Brigade**

**12 81mm Mortars  
18 60mm Mortars**

**4 120mm Mortars  
4 81mm Mortars  
6 60mm Mortars**

## Heavy Brigade

**Mortar Platoon (1 per Bn)**



**1 FDC Vehicle**

## Light Brigade

**Mortar Platoon (1 per Bn)**



**Rifle Company**



**1 FDC Vehicle**

## Ranger Battalion

**Mortar Platoon**



**1 FDC Vehicle**

# BCT Distribution



**36 120mm Mortars  
in the BCT**

**12 81mm Mortars  
in the BCT**

**18 60mm Mortars  
in the BCT**

**Each Battalion  
Mortar Platoon**



**M252 81mm**



**FDC Vehicle  
with 2 M23  
MBCs \***

**12 Mortar Carriers at  
Battalion Level**

**Each Company  
1 Mortar Section**



**M224 60mm**



**Each Vehicle has  
1 M23 MBC\***

**18 Mortar Carriers at  
Company Level**

**RSTA Squadron  
One Squadron  
Per Brigade**



**6 X 120mm**



**Each Vehicle has  
1 M23 MBC\***

**6 Mortar Carriers in  
RSTA Squadron**

**\* Upgrade to MFCS (H) 3<sup>rd</sup> BCT FY04**

# Mortar Fire Control System



## MFCS (H) Heavy

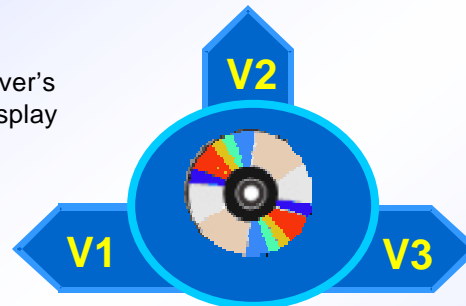


- Software
- Hardware
- Commanders Interface

## MFCS BCT



FUE Aug 04



MFCS  
Software

## MFCS (L) Light



Parallel Path: LW and COTS

Same Functionality as

MFCS (H) (< 25 lbs.)

FUE 3QFY07

MFCS (L) Light Objective  
solution is complete LW  
integration

## MBC Light

FUE Nov 03



MBC  
Software

Interim System

**Improved Capabilities ...**  
**Accuracy**  
**Survivability**  
**Responsiveness**  
**Command & Control**

MBC FUE Sep 02  
 MFCS(H) IOT Sep 02  
 MFCS(H) FUE Apr 03

# Future Systems



## Light Forces Concept

- Add 120mm mortar to Light Divisions at BN level

- Provides BN CDR flexibility through full spectrum of conflict

- Current systems: **827**

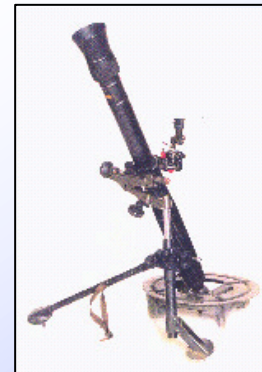
- Projected fielded 120mm systems: **1143**



120MM



60MM



81MM

## Future Goals

- Reduce mortar family caliber from 3 to 2
- 30% to 50% reduction in system weight
- Increase system range and lethality
- Maintain Rate of Fire

**Implemented  
Light Forces  
Concept**





# Precision Guided Mortar Muniton

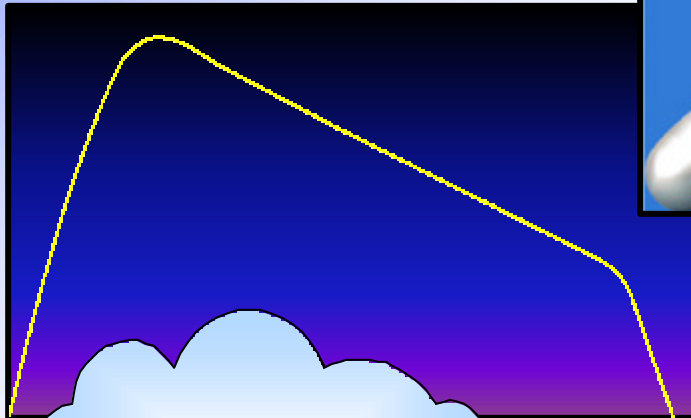
## Key Performance Parameters



**PRECISION**  
1 m CEP



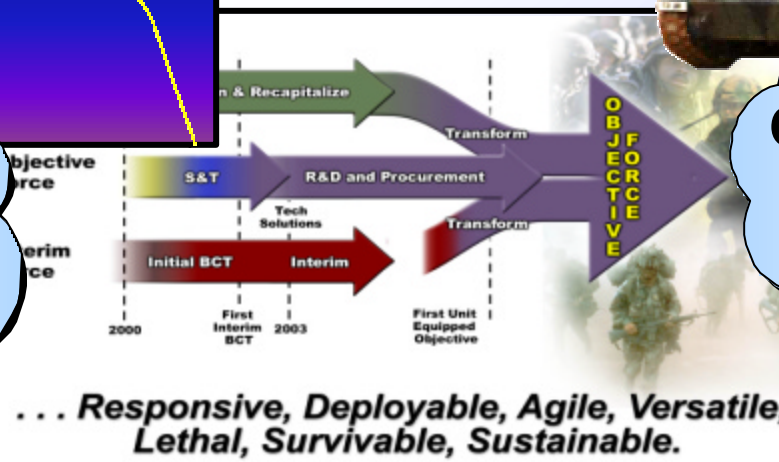
**LETHALITY**  
Incapacitate  
Personnel



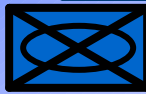
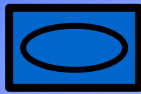
**RANGE**  
15 km Desired  
12 km Required



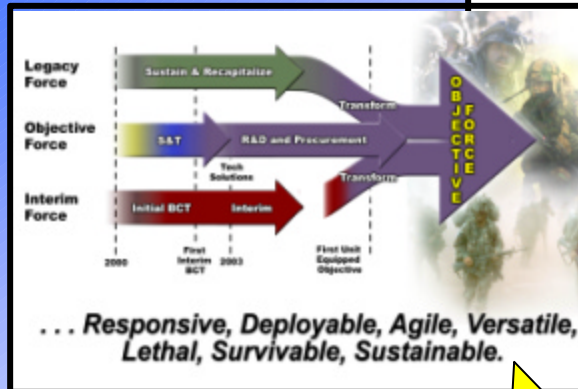
**COMPATIBILITY**  
Existing 120mm  
Mortar System



# PGMM Operations



RGR



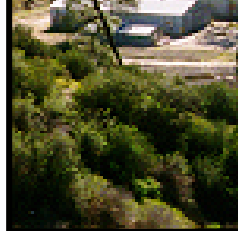
Glide

Acquire

Precision  
Range  
Lethality  
Compatibility

Destroy  
Target

Precision  
Engagement  
for IBCT and  
Objective Force



Leverages Existing Fire Support Systems  
Reduces Collateral Damage



Masonry Structures  
Earth and Timber Bunkers  
Light Armor Vehicles

Precision Munitions Increase Warfighter Effectiveness



# 2002 International Infantry and Joint Services Small Arms Symposium and Exhibition

## Mortar Overview



**LTC Larry Hollingsworth**  
**PM Mortars**

*PEO Ammunition*



# 2002 International Infantry & Joint Services Small Arms System Section Symposium Atlantic City



**Presented by  
Mike O'Dwyer**

**[mikeodwyer1@compuserve.com](mailto:mikeodwyer1@compuserve.com)**



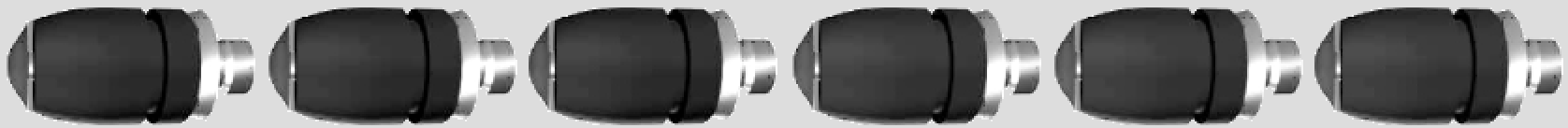
**Australia**  
**Metal Storm Ltd** ACN 064 270 006  
Level 34, Central Plaza One  
345, Queen St  
Brisbane 4000  
Australia  
Phone + 61 7 3221 9733  
Fax + 61 7 3221 9788

**United States**  
**Metal Storm Inc.**  
4350 N Fairfax Drive  
Suite 810  
Arlington VA 22203  
Phone 703 248 8220  
Fax 703 248 8262





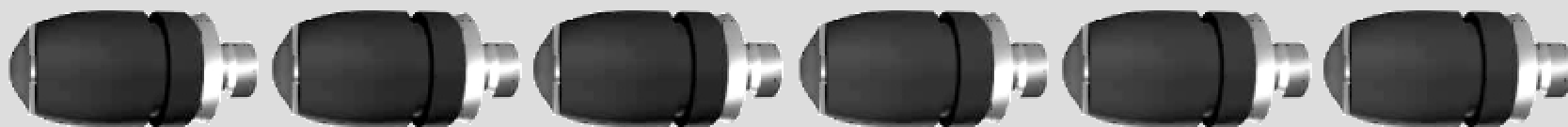
## ***MULTIPLE EFFECTS WEAPON SYSTEM***



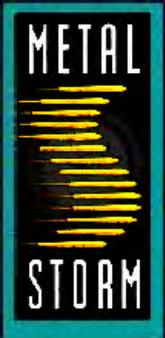
- No moving parts. Only the bullets move.
- One Simple Tube is an Operating Weapon.
- Multiple Barrels / Multiple Effects in One System.
- Electronically Variable Rates of Fire.
- High Ammunition Density / The Magazine is the Weapon.
- Demonstrated to 36 Barrel-Group Pod.
- Increased Reliability, Little Maintenance.



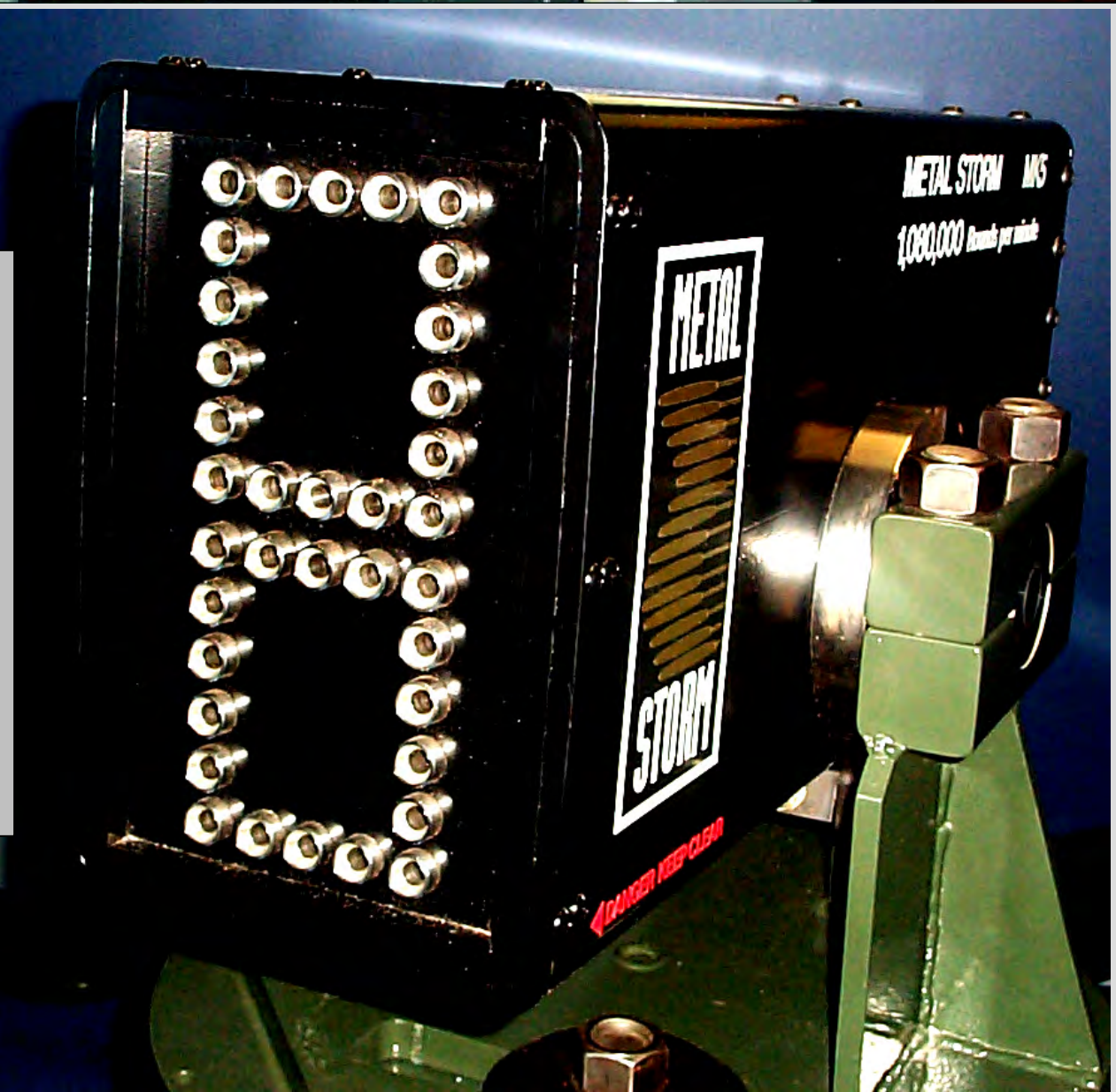
## ***MULTIPLE EFFECTS WEAPON SYSTEM***



- **Confirmed Calibers: 9mm, 40mm, 60mm.**
- **On the Way: 7mm, .50Cal, 81mm.**
- **Confirmed Pressures to 50K psi.**
- **Reloading Demonstrated via Multi-Shot Cartridge.**
- **All Rounds in the Stack are Ballistically Consistent via Graduated Propellant Loading.**
- **Electronic Keying for User[s] Authorization.**



**A TOTALLY  
Electronic System  
Fire One barrel  
Fire Any barrels  
Fire All Barrels  
  
Infinitely Variable Rates  
  
Mix the Calibers  
Mix the Ammo Types**







## **GVT. FUNDED RESEARCH PROGRAMS**

- **Advanced Individual Combat Weapon**
- **Area Denial Weapon System**  
[Landmine Replacement]
- **Joint US / Australian R&D Program**  
[Vehicle Self Defense]
- **High Pressure Barrel**





## **COMPANY RESEARCH ACTIVITY**

- **Variable-Lethality Handguns**
- **20mm OICW Equivalent Ammunition**
- **25mm OCSW Equivalent Ammunition**
- **Access Denial Weapon System**
- **Firefighting Pod-System**



## **GVT. FUNDED RESEARCH PROGRAMS**

- **Advanced Individual Combat Weapon**

# ***The Concept*** -- A Two Barrel Hybrid:

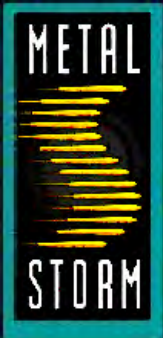
Top Barrel: **Metal Storm Stacked-Rounds Tube**

Bottom Barrel: **Conventional 5.56 Assault**



## **TWO Barrels. ONE Magazine**

- 20/30/40mm Top Barrel[s]
- Fully Compliant with Land Warrior
- Lethal Lightweight Compact



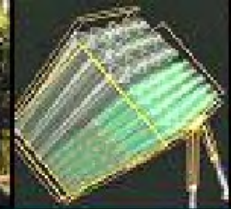
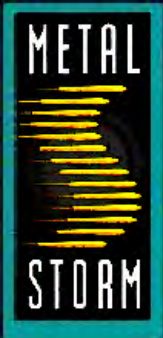
# The Program: Advanced Individual Combat Weapon

Two Barrels - One Magazine

The prototypes being developed will have a dual barrel capability to fire both 20/40mm bursting munitions and standard 5.56mm NATO ammunition







DEPARTMENT OF DEFENCE  
DEFENCE SCIENCE & TECHNOLOGY ORGANISATION

**DSTO**



## Advanced Individual Combat Weapon [AICW]

Two Barrels - One Magazine

Lightweight - Rugged - Lethal - Prone Firing

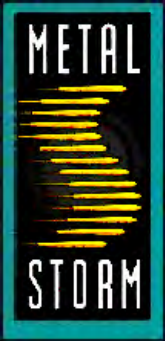
A Hybrid:

Metal Storm  
Integrated  
with a  
5.56 Styer  
Infantry Rifle



Top Barrel:  
20mm /30mm /40mm

DSTO Prototype [30mm Top Barrel]



**AICW: Weight is DOWN. Lethality is UP.**

## KPPs

**Weight**  
**Lethality**  
**Firing  
Positions**  
**Ruggedness**

## AICW

**10-12 Lbs.**  
**20, 30 and 40mm Airbursting**  
**Includes Prone [Only one Magazine]**  
**Totally Removes One Mechanical Barrel**

Can Adapt onto Many : ie- M16, M4, SMG's



## **GVT. FUNDED RESEARCH PROGRAMS**

# **Area Denial Weapon System**

[Landmine Replacement]

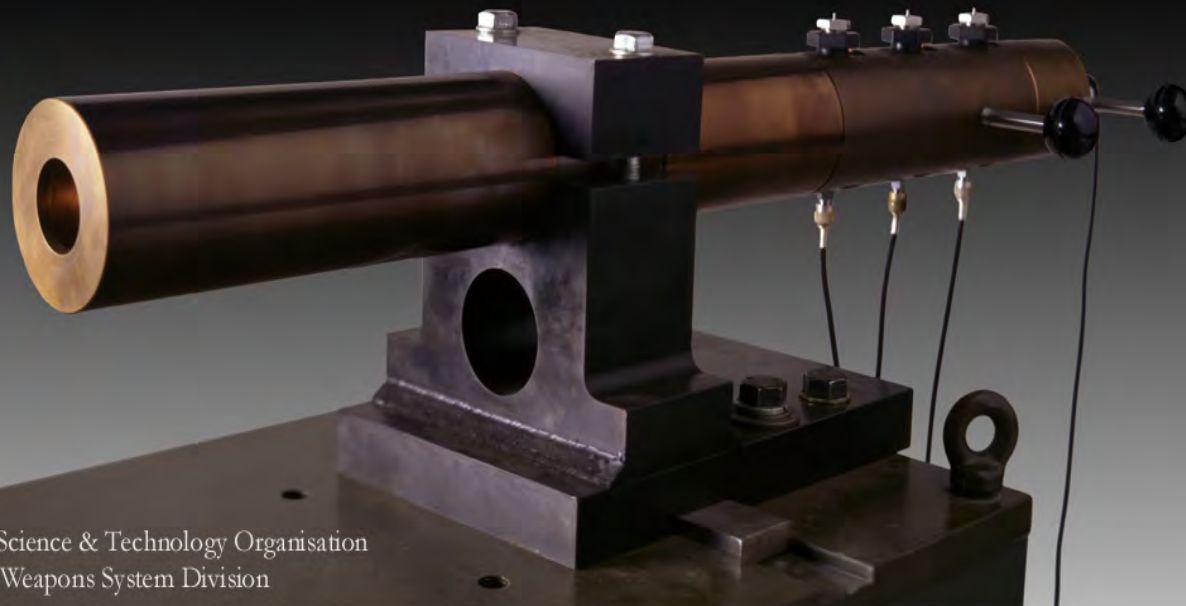


Department of Defence

Defence Science and Technology Organisation

## Mk1 40mm Grenade Launcher Testbed

The Program is based on the existing success of the 40mm stacked-tube research completed by DSTO



Defence Science & Technology Organisation  
Weapons System Division



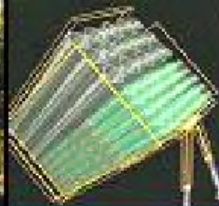
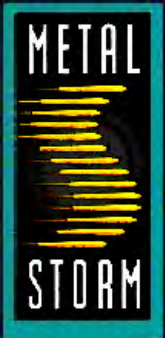
Two still images taken from the high speed film record of the 20,000 rpm firing in the Mk1 test-bed.

Round 1 just exiting  
from barrel

100mm  
scale grid

Round 2 exiting ~ 3ms later,  
partly obscured by smoke cloud

Round 1



DEPARTMENT OF DEFENCE  
DEFENCE SCIENCE & TECHNOLOGY ORGANISATION

**DSTO**

## Experimental Program

- 40mm Multi-Shot Lightweight Composite Cartridge Case

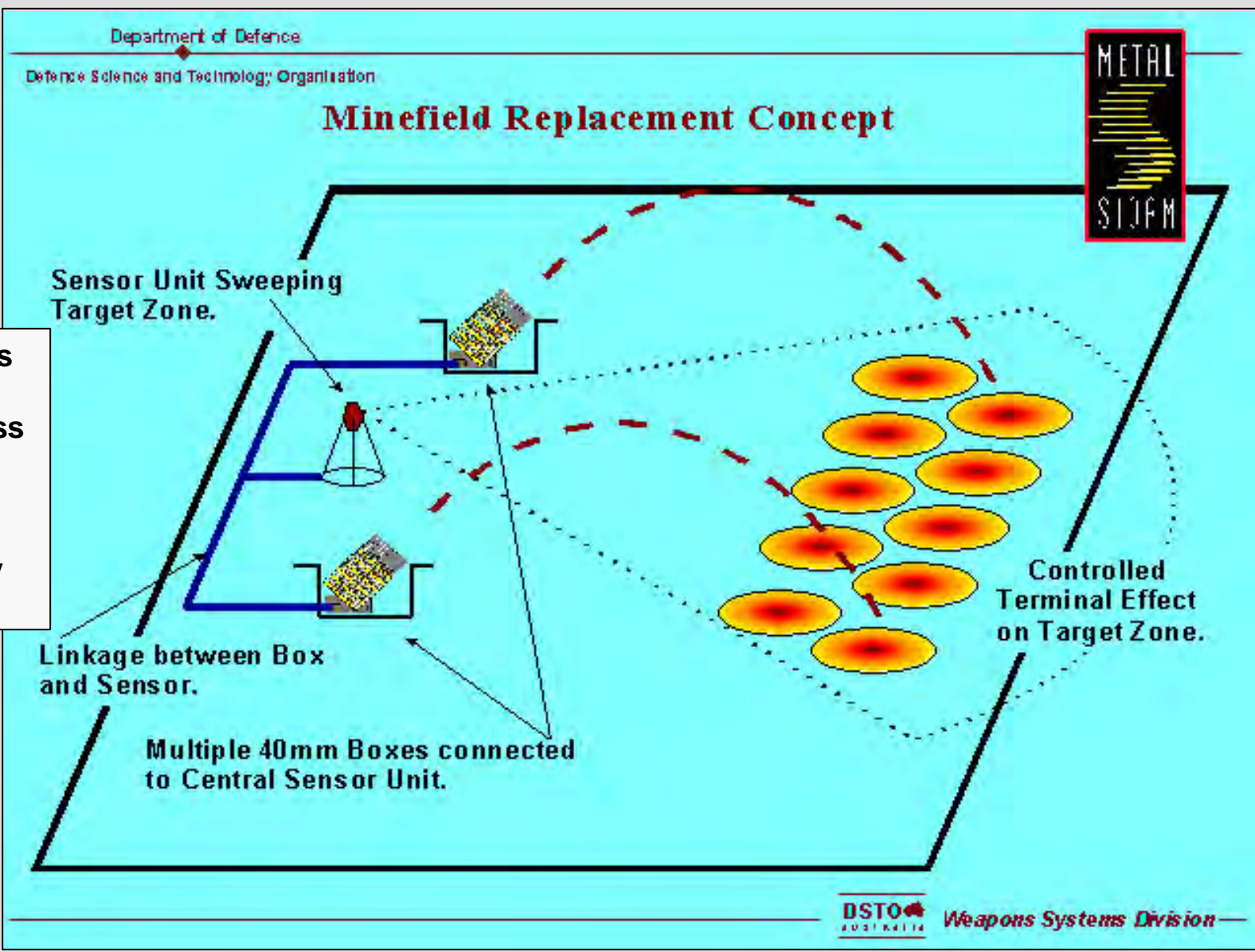
Cartridge unit is completely self contained



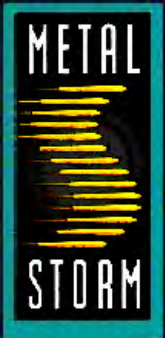
Projectile Weight	270g
Projectile Length	96mm
Propellant Type	AR2205
Pressure	110 / 150 MPa
Muzzle Velocity	240 / 316 m/s
Dispersion	20m
Maximum Range	1,700m

The 40mm system has fired at the rate of 20,000 rpm. per barrel





The Program is based on the existing success of the 40mm stacked-tube research completed by DSTO



## Landmine Replacement System

Each box holds 600 grenades

Fires Lethal and Less-than-Lethal

Fires HE /smoke / flares etc.

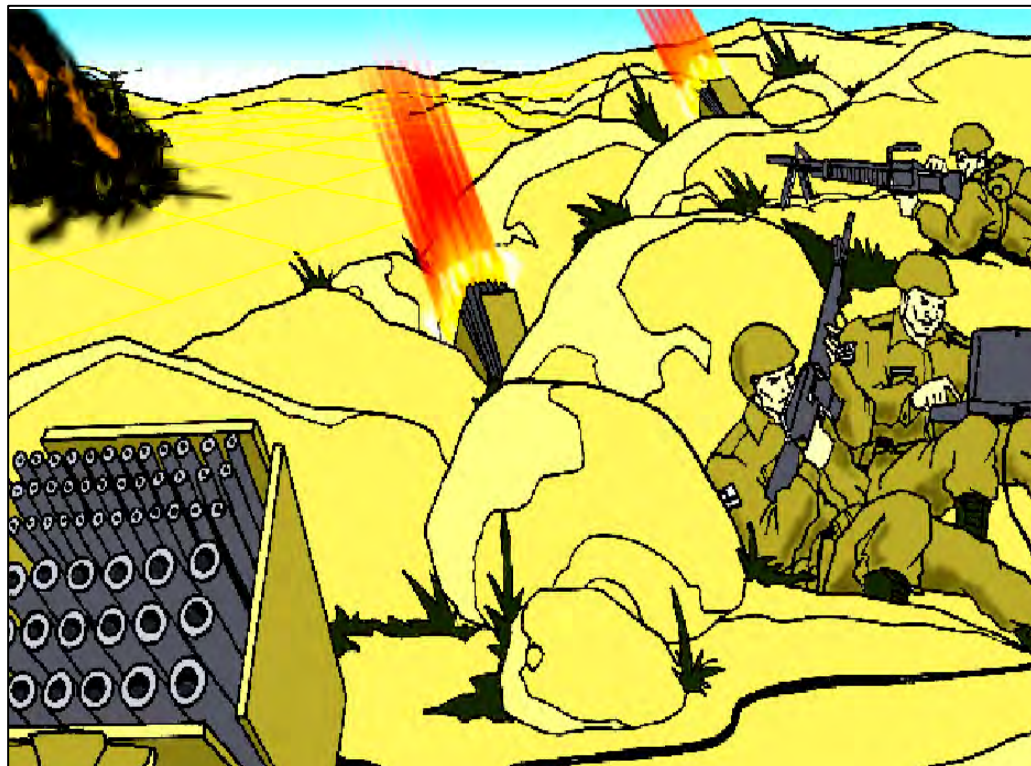
Splaying barrels / Variable Impact

Max rate per box 2M rpm

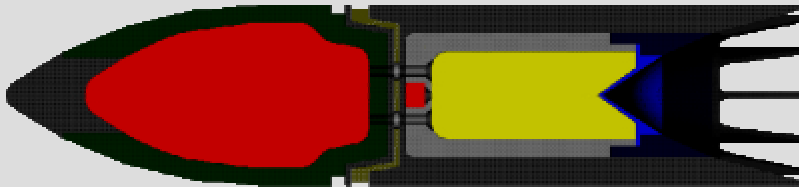
Man-in-the-loop capable

No Moving parts

100% Electronic



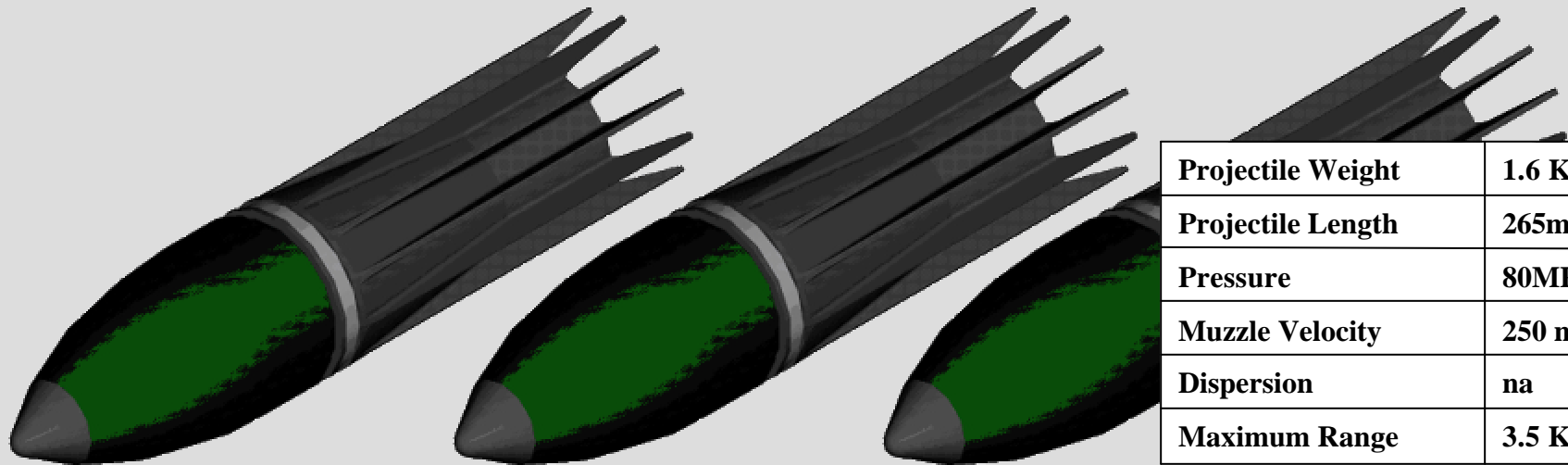




## Now Firing in 60mm Configuration

The 60mm test firing proves the capability of a Metal Storm weapon system to

- .. Destroy vehicles or infrastructure
- .. Damage or disable armoured vehicles
- .. Raises the potential lethal area to 4-5 times greater than 40mm rounds

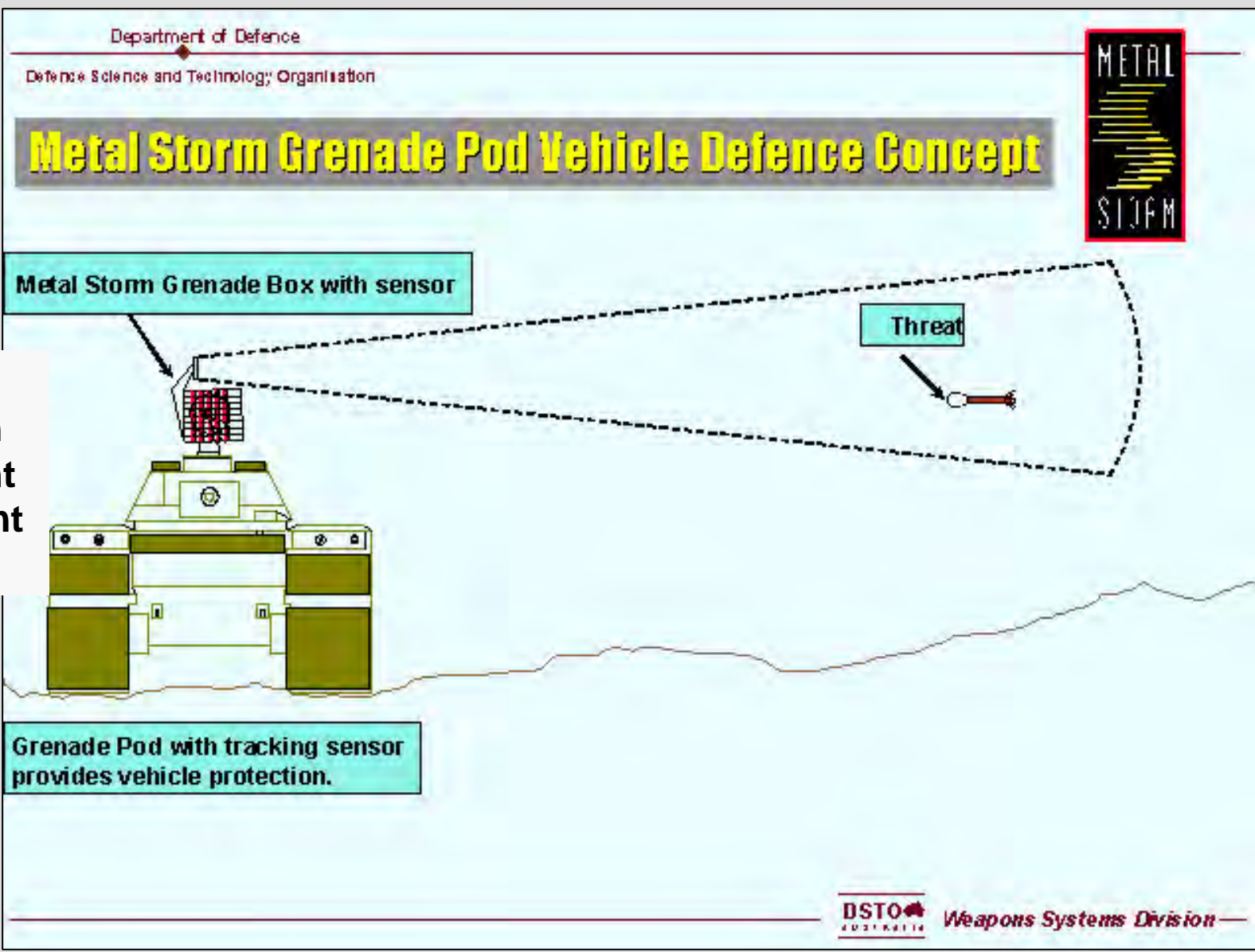
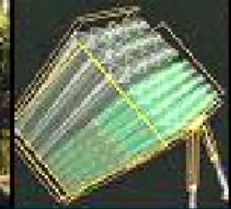
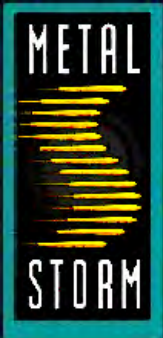


Projectile Weight	1.6 Kg
Projectile Length	265mm
Pressure	80MPa
Muzzle Velocity	250 m/s
Dispersion	na
Maximum Range	3.5 Km



## **GVT. FUNDED RESEARCH PROGRAMS**

- **Joint US / Australian R&D Program**  
[Vehicle Self Defense]



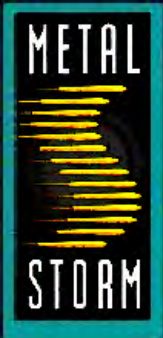
Joint US /  
Australian  
Government  
Development  
Program



## **GVT. FUNDED RESEARCH PROGRAMS**

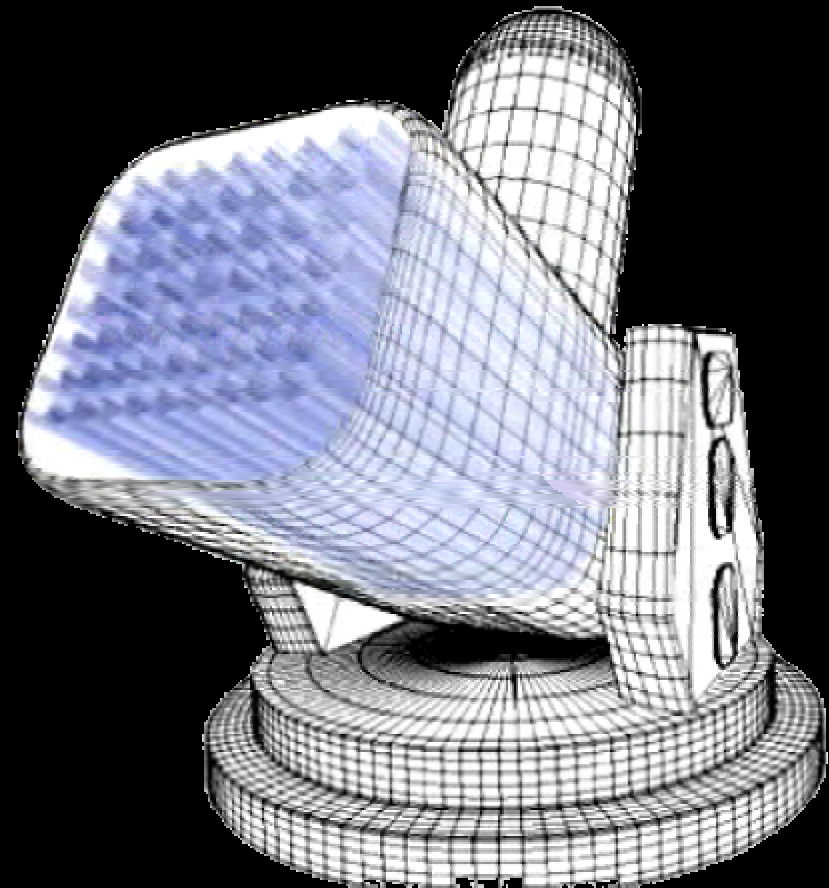
- **High Pressure Barrel**

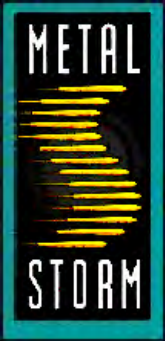




# METAL STORM

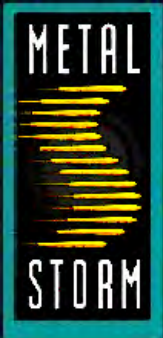
**HIGH PRESSURE BARREL:**  
The focus will include innovative, multi-purpose, high-pressure designs and projectiles for rifled barrels to demonstrate capabilities from a tactically relevant 0.50 caliber system.





## COMPANY RESEARCH ACTIVITY

- **Variable-Lethality Handguns**



## The Operator can Select:

- Semi Auto Firing
- Double Tap @ 45,000 rpm
- Triple Tap @ 60,000 rpm
- High Energy Traveling-Charge Mode at 500,000 rpm \*

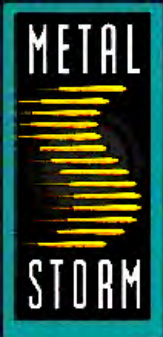
**VLe:**

**MULTIPLE  
EFFECTS  
Handgun**



\* Firing 2 Rounds at 500,000 rpm 'pushes' the First Round.  
Up to 56 % increase in Kinetic Energy.

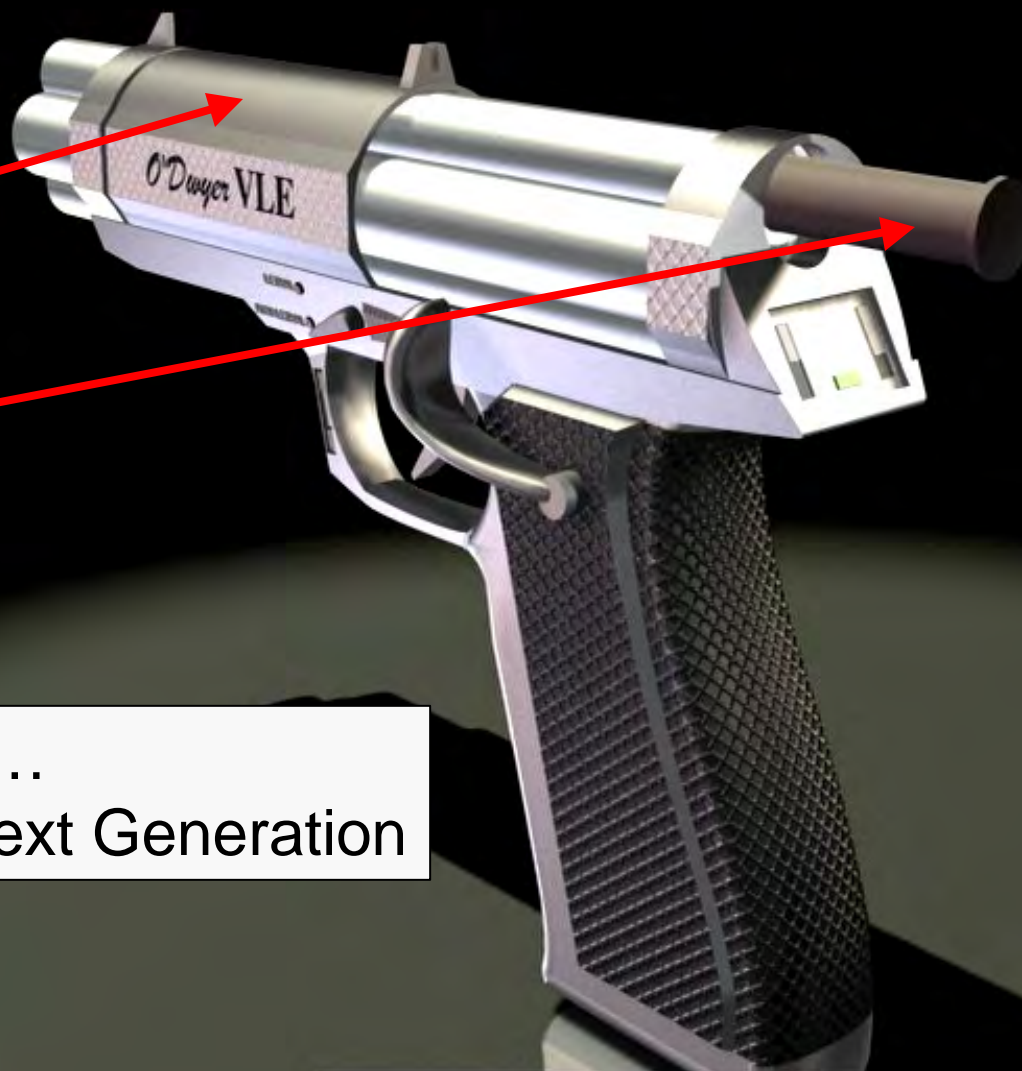




**Operate the  
Reload-  
Slide**

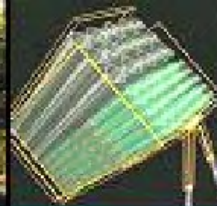
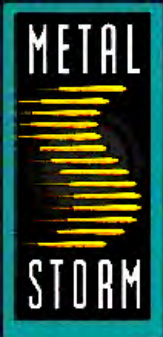
**to  
Reload a  
Multi-Shot  
Cartridge**

**and  
generate  
Back-Up  
Electrical  
Energy**



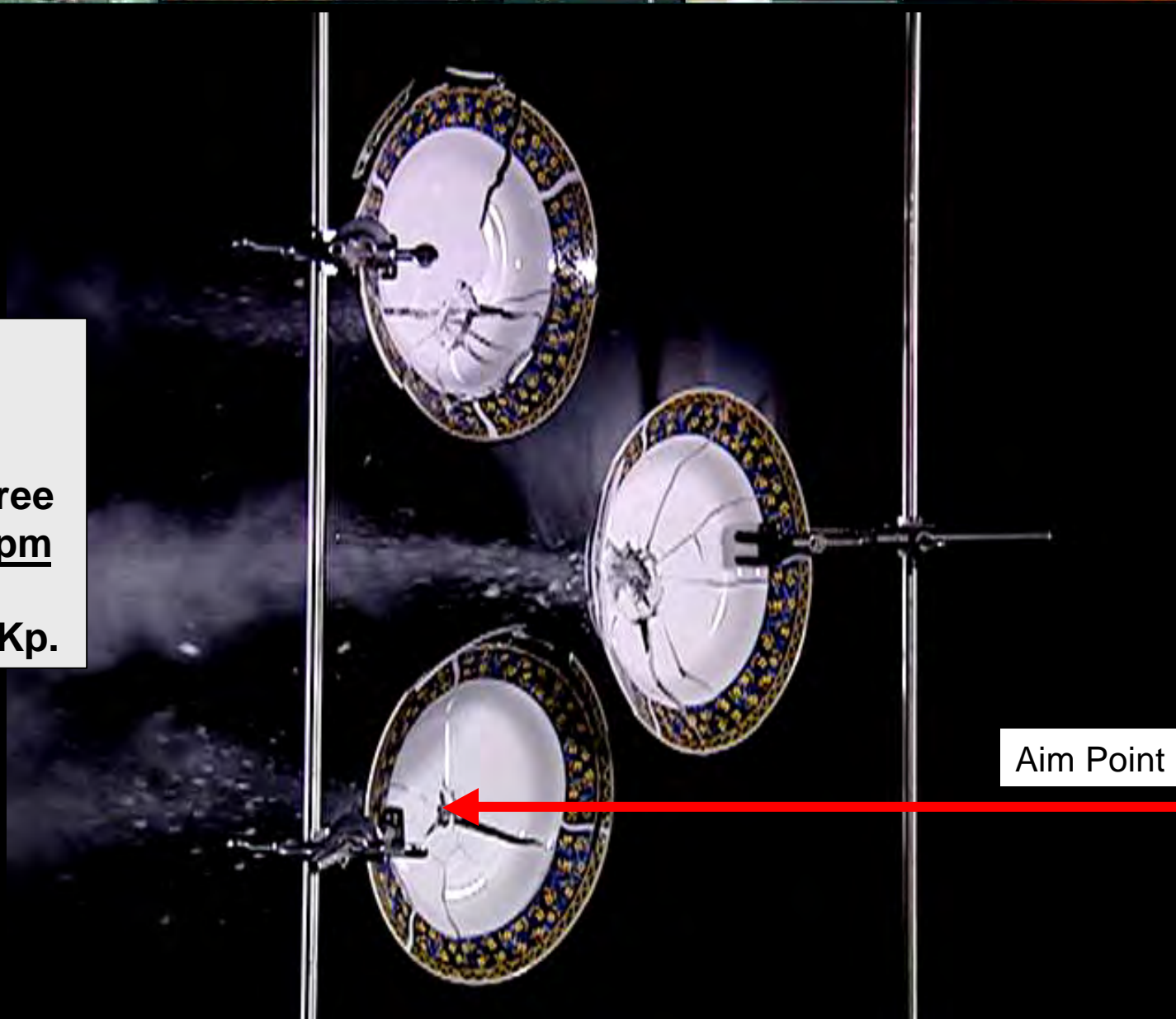
**VLe II...  
The Next Generation**



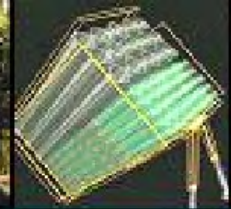
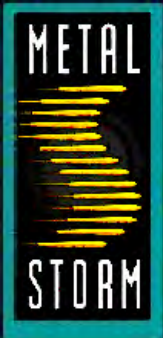


## Triple-Tap Demonstration

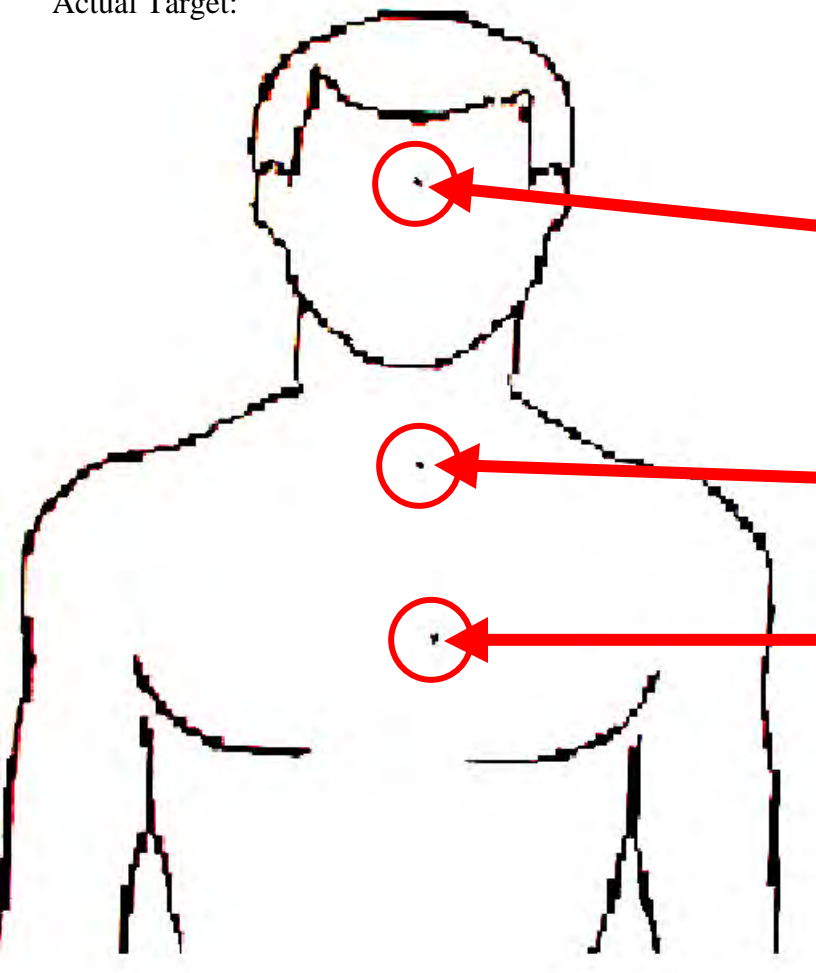
Debris trails of Three  
bullets at 60,000 rpm  
illustrates the  
increased Hp and Kp.



Aim Point



Actual Target:



3<sup>rd</sup> Round

2<sup>nd</sup> Round

Aim Point

### 9mm VLE Handgun

- Range 8 yds

### Rate of Fire

- 2-3 @ 60,000 spm
- 1-2 @ 45,000 spm

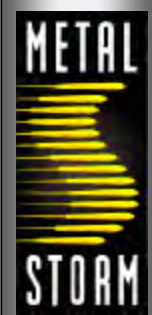
### Firing Duration

- 0.0023 secs.

### Vertical Separation of Shots

- |         |         |
|---------|---------|
| Total   | 30.5 cm |
| • 2-3 @ | 18.5 cm |
| • 1-2 @ | 12.0 cm |

Click Above



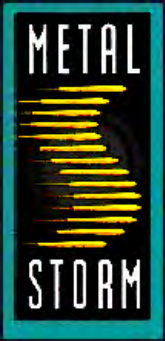
Triple-Tap  
**40 Seconds**  
Demonstration Video Clip



## **COMPANY RESEARCH ACTIVITY**

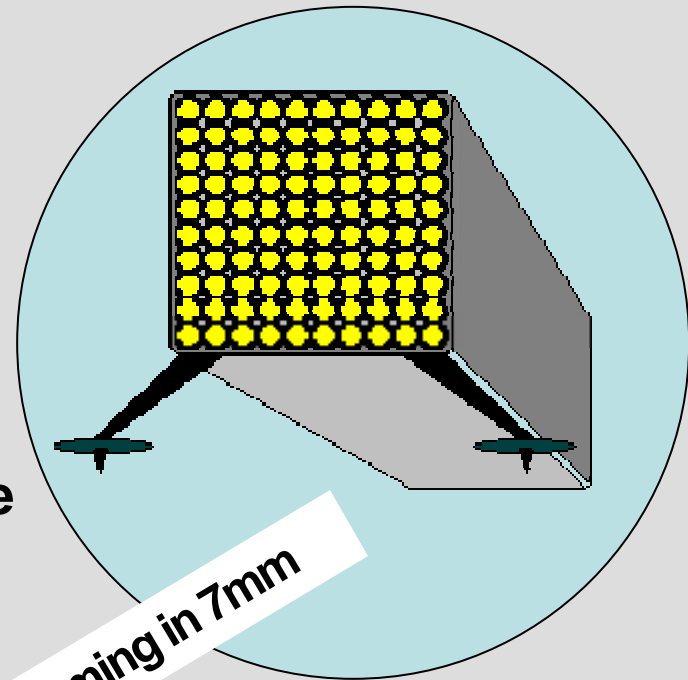
- **Access Denial Weapon System**





# Repeatable Access Denial System

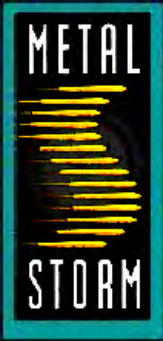
- Cover Withdrawal / Set Ambush / Asset protection
- 100 Barrels. 400 Rounds [ .22 caliber ]
- Random-Fire Mode to Cover Withdrawal
- 40 Secs. of fire at 600 rpm
- 'Explosive' Fire at 4.5 million rpm.
- Programmable to Imitate heavy Caliber Fire
- 4in square. 6in long. 5lb.



Now Coming in 7mm

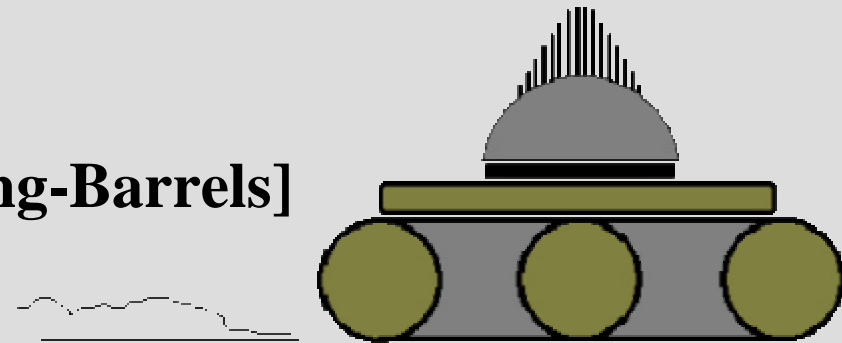


# Robotic Applications

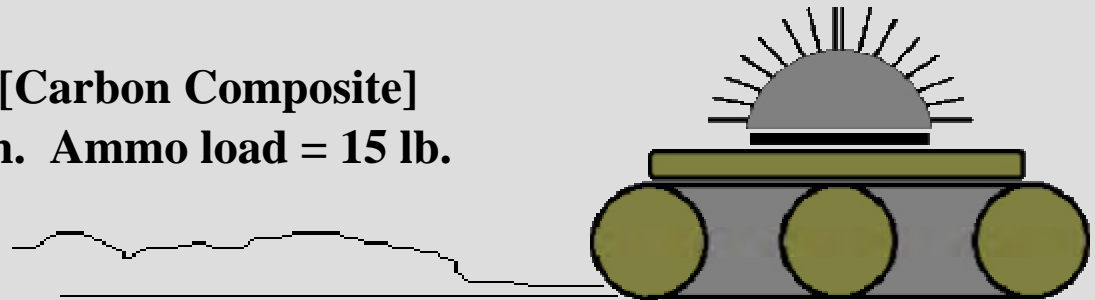


- **Urban Combat Robot [Folding-Barrels]**

Approx Length 2.5 ft. Height 20 in.

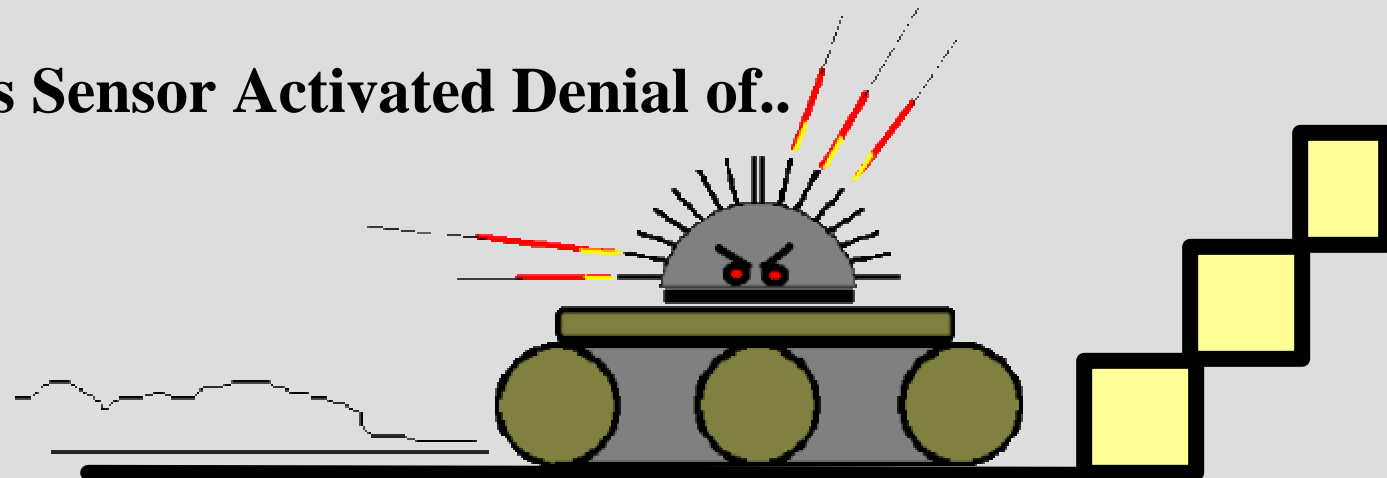


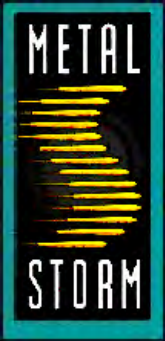
**B. Unfolded: 116 Barrels [Carbon Composite]**  
1,508 Projectiles 7mm x 11mm. Ammo load = 15 lb.



**C: Autonomous Sensor Activated Denial of..**

- Choke Points
- Stairs
- Doorways





## LIGHT Revolving Gun-Carousel

1. Area Clearing 2. Cave Clearing 3. Set Ambush 3. Psychological Effect

1,000 rounds. 100 barrels

Sustained fire at 600 rpm = 1.7 mins.

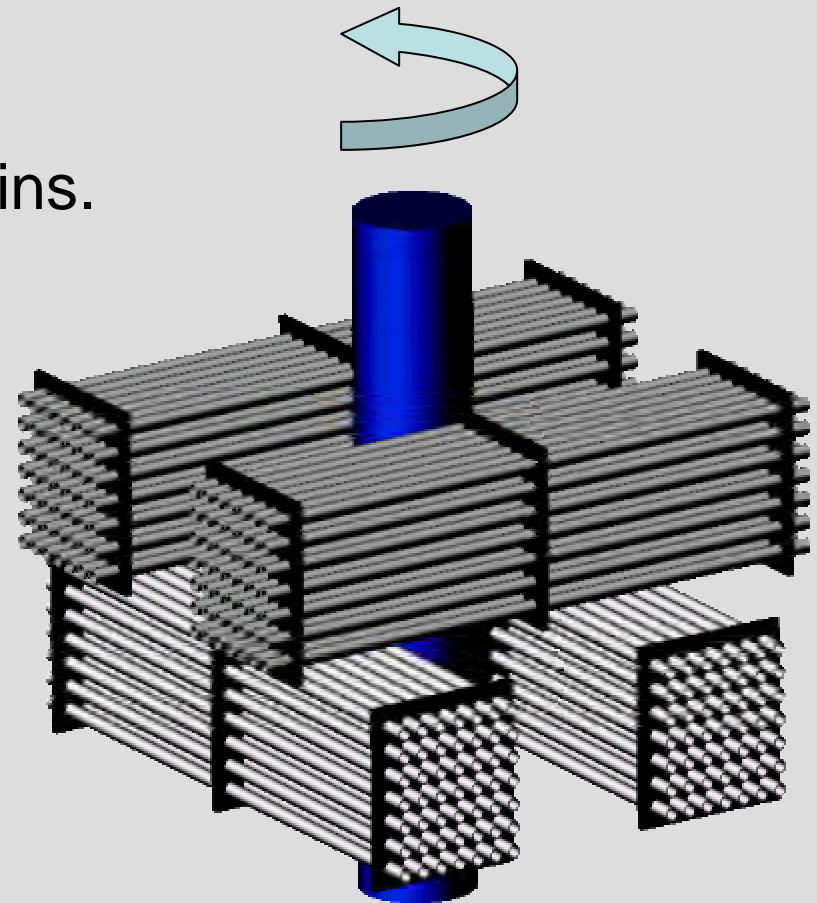
Max rate of fire = 4.5 million rpm

Composite 9mm barrels = 25 lb

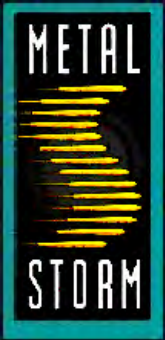
Ammunition = 20 lb

No moving parts in the guns

Can fire 360 degrees  
or to set quadrants

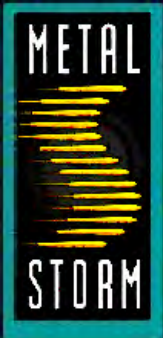






**LIVE FIRING DEMO.**

**-- 20 Seconds --**



### **VLe Handgun:**

- \* Semi Auto
- \* Double Tap  
@ 45,000 rpm
- \* Triple Tap  
@ 60,000 rpm
- \* High Energy  
@ 500,000 rpm

### **6 Barrel Testbed:**

- \* 600 rpm burst
- \* 90 rounds  
@ 120,000 rpm

### **40mm Testbed:**

- \* 4 Rds  
@ 6,000 rpm

# **METAL STORM**

*An Electronic Firing Demonstration*

*Blossom Point, Maryland*

*July, 2000*

Live Firing

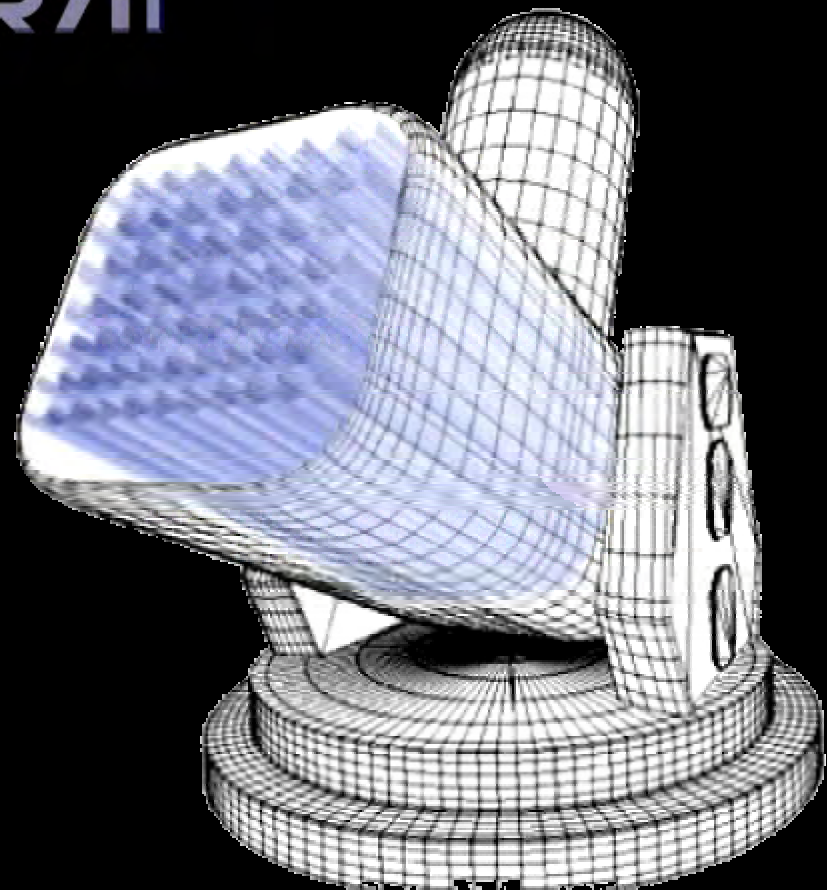
**20 Seconds**

Demonstration Video Clip



# METAL STORM

QUESTIONS ?



# ***Land Warrior** Compatible*

## **The Weapon**

- Light Weight Thermal Sight
- Multifunctional Laser
- Color Daylight Video Sight (DVS)

## **The Integrated Helmet Assembly (IHAS)**

- Helmet Mounted Color Display
- Land Warrior Assault Helmet
- Audio System
- Night Display

## **The Computer/Radio Subsystem (CRS)**

- Comms/Nav Box / GPS / Inertial Nav
- Handheld Flat Panel display
- Secure Voice and Digital Comms

## **The Software Subsystem**

- Common Tactical Picture
- Map: Own / Others Location
- Graphics and Orders
- Power Ops / Video In / Out







METAL  
STORM





AMC



TACOM-  
ARDEC



## **2002 International Infantry & Joint Services Small Arms Systems Section Symposium, Exhibition & Firing Demonstration**

**MAJ Jason Robbins**

**US ARMY, ARDEC**

**Deputy, Artillery and Mortars Division**

**973-724-3155**

*Robbinsj@pica.army.mil*  
*Afran@pica.army.mil*







AMC



TACOM-  
ARDEC

# Responsive Accurate Mission Module (RAMM)

## Objective

- *Design/Develop a lightweight highly responsive automated unmanned indirect fire module that will integrate onto multiple platforms and provide accurate remote (SENSOR-TO-SHOOTER) capability through a digital network to engage Area of Operation targets.*



- *In 1998 FSAC, developed the first unmanned mortar technology demonstrator called Dragon Fire for the MCWL which successfully demonstrated the utility of a remotely controlled indirect fire system.*

**Lethality without Soldier Vulnerability**







AMC

# Responsive Accurate Mission Module (RAMM)

## Initial Concept Demonstrator



TACOM-  
ARDEC



### Demonstrator Characteristics:

- Unmanned/remote controlled after emplacement
- Self-orienting/Self-positioning
- Able to receive digital call for fire and MET data
- Capable of internal ballistic computation for firing solutions
- Automatic gun pointing, ammunition loading and firing
- 360 degree traverse firing
- Transportable in V-22 aircraft

- ***Dragon Fire was single shot, stationary, remote controlled, with automated fire control and gun pointing***
- ***RAMM will be multi shot, highly mobile, modular system with high level functionality leveraging Dragon Fire's proven technology***

### Dragon Fire Demonstrator





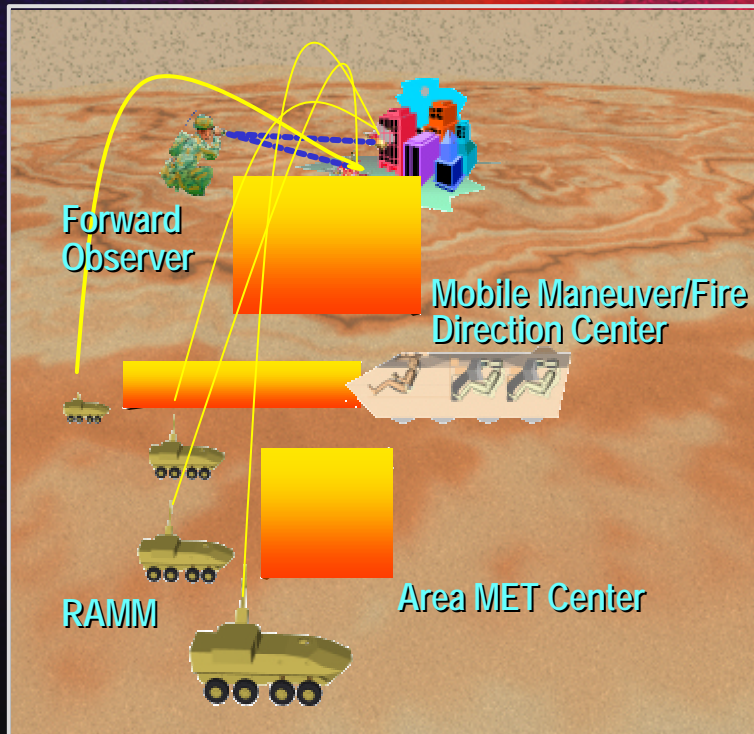


AMC

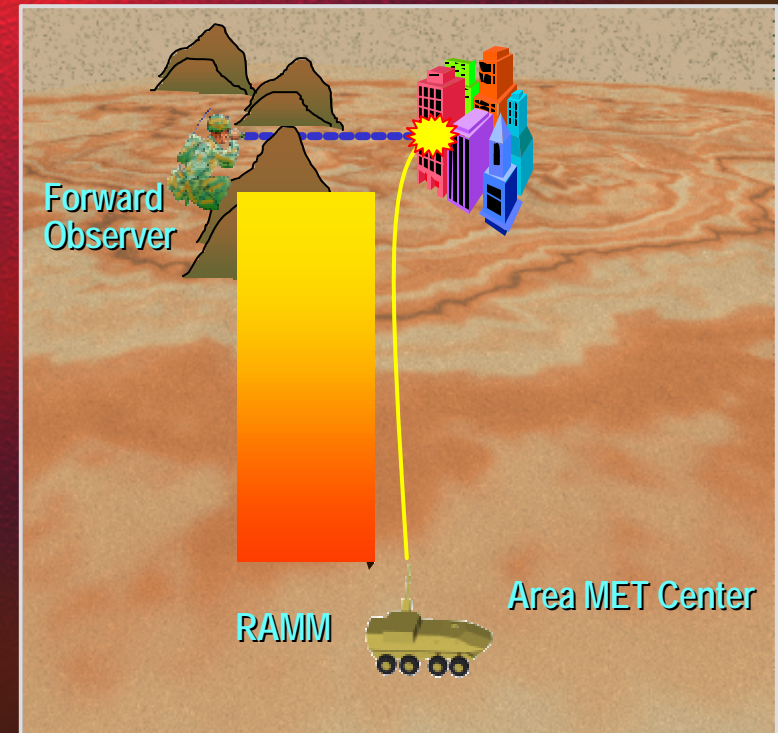


TACOM-  
ARDEC

# Responsive Accurate Mission Module (RAMM) Control Network Architecture



• **Traditional Control Architecture**



• **Direct Control from FO**  
(Aid in MOUT Combat)





AMC

# Responsive Accurate Mission Module (RAMM)

## Module Concept

### Performance Baseline



TACOM-  
ARDEC

Capability	Current Capability	Threshold	Objective
System Weight	7000lbs (Dragon Fire)	6000lbs (includes 2000lbs in armor)	4000lbs
MV variation	2.5m/s (M120)	1.5 m/s	1 m/s
Pointing accuracy Elevation (1 Sigma)	2 mils	1 mil	.5 mil
Deflection (1 Sigma)	4 mils	1 mil	.5 mil
Responsiveness	8-12 min. (M120)	15 sec	11 sec
Crew Size	4 (M120 & M121)	0	0
Elevation Range (Degrees)	40 to 85( M121)	0 to 85	-3 to 85
Traverse Range (Degrees)	90 (M121)	360	360

Modular Appliqué Armor

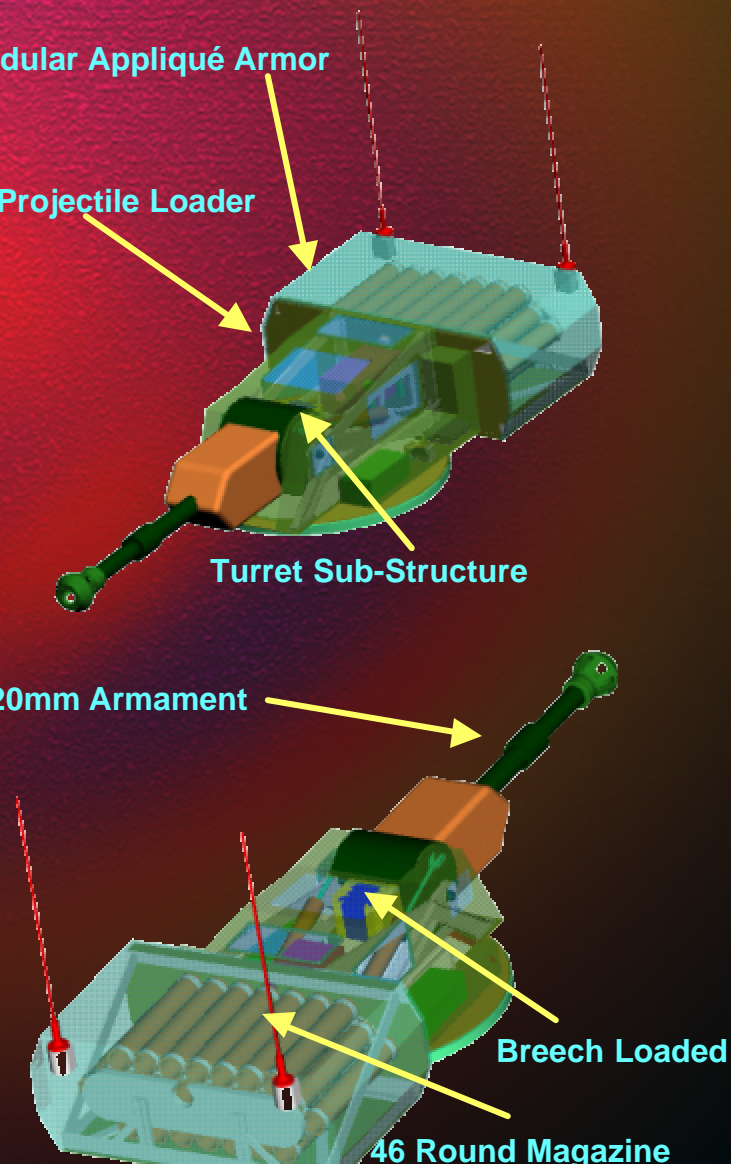
Projectile Loader

Turret Sub-Structure

120mm Armament

Breech Loaded

46 Round Magazine







AMC



TACOM-  
ARDEC

# Responsive Accurate Mission Module (RAMM)

## FCS and BCT Vehicles



**GENERIC FCS VEHICLE/RAMM  
IN C130 AND RAILWAY  
TUNNEL GAGE**



**RAMM ON FDRU  
Or Robotic follower  
vehicle**



**RAMM MOUNTED ON  
GENERIC FCS VEHICLE**



**RAMM MOUNTED ON LAV III**



*Fire Support Armaments Center*





AMC



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ARDEC

# Responsive Accurate Mission Module (RAMM)

## Why 120mm Mortar?

### Advantages :

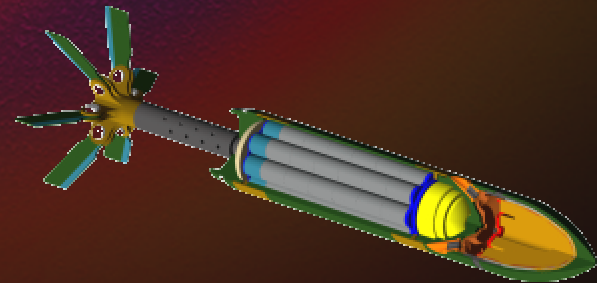
- **Interoperability** many NATO 120mm mortar varieties
- **Accuracy** pin point accuracy w/ PGMM, automated pointing improves conventional round accuracy
- **Lethality** 120mm HE provides 65-85% lethality of current 155mm HE
- **Range** 300 m (HE) 200m (Smoke/illumination), XM984 and PGMM out to 15Km
- **Simplicity for Automation** rounds are a unitized package (propellant/primer/etc).
- **Relatively Lightweight** armament compatible with FCS size platforms
- **Economy** advanced rounds at end of development cycle, low conventional round cost



PGMM



Conventional Rounds



XM984

QUICKLOOK





AMC

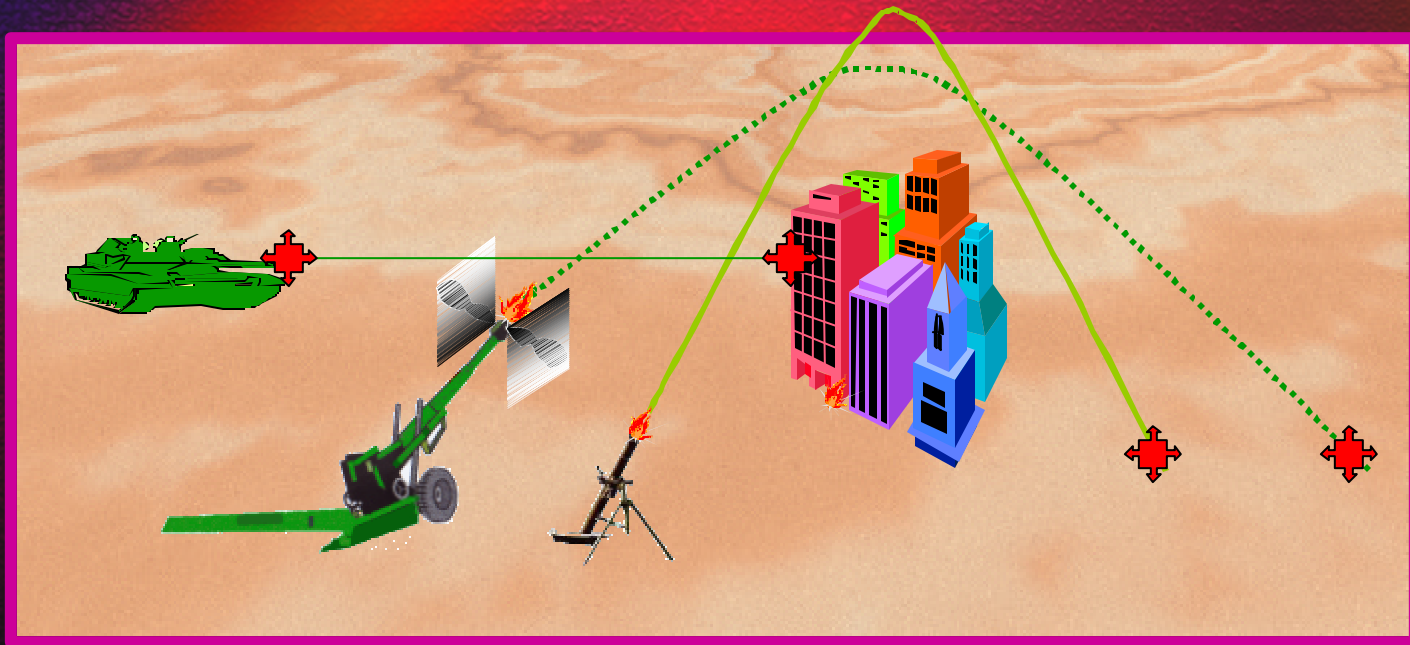
# Responsive Accurate Mission Module (RAMM)

## Basic Missions Concept



TACOM-  
ARDEC

***RAMM is a hybrid indirect fire system that combines select capabilities of traditional mortars, artillery and direct fire systems.***



- ***Indirect Suppressive Fire***
- ***Indirect Target Degradation***
- ***Indirect Harassment Fire***
- ***Indirect Soft target strikes***
- ***Smoke Screen Fire for obscuration***
- ***Battlefield/Target Illumination***
- ***Very High or Low Angle Fire for MOUT***
- ***Limited Direct Fire Capability***
- ***Precision Strike against earth and timber bunkers, masonry walls and***





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ARDEC

# Responsive Accurate Mission Module (RAMM)

## Basic Networked Operation

***Widely dispersed RAMM systems can concentrate fire power on single or multiple targets to be used as a **FORCE MULTIPLIER*****



Utilizing CDAS technology, the Future Warfighter will be able to:

- Achieve high ROF by cycling multiple RAMM units
- Conceal location from enemy fire by firing from multiple locations
- Optimize individual magazine inventory firing select rounds from select RAMM systems



Fire Support Armaments Center



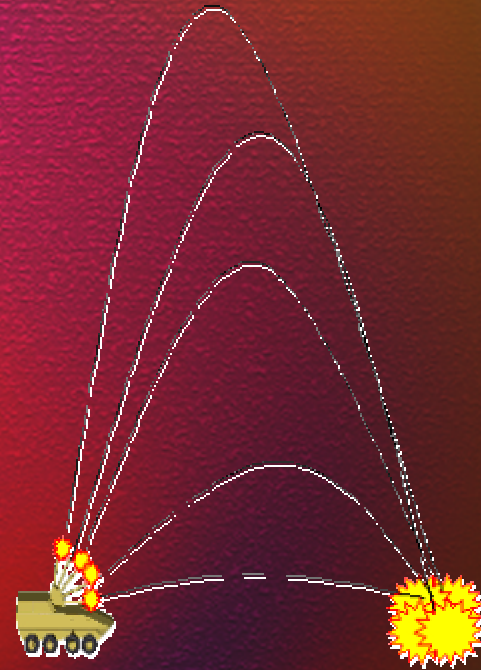
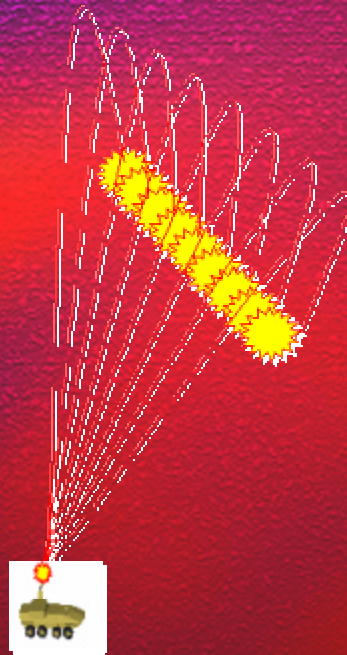
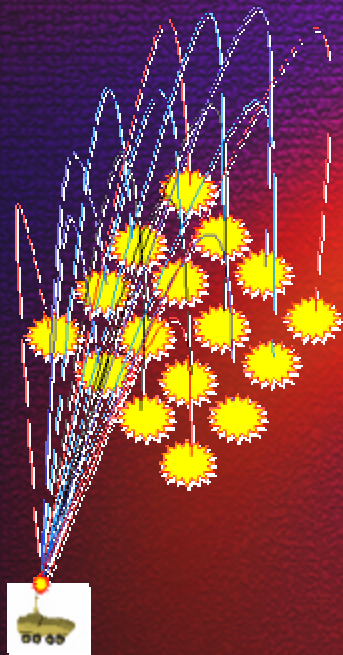


AMC



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# Responsive Accurate Mission Module (RAMM)



***Improved accuracy allows stowed kills to be optimized for:***

- ***Pre-programmed patterned or random fire impacts***
  - ***Area saturation/denial coverage***
  - ***Random harassment fire***
  - ***Linear coverage to intersect stationary targets***
  - ***Linear coverage to engage constant velocity moving targets (trains or convoys)***
- ***Multiple round simultaneous impacts (MRSI)***





AMC



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Responsive Accurate Mission Module (RAMM)

# Summary

Potential Industry Partnerships

Inductive Fuze and setting systems

Software Development

Hardware Fabrication

20mm Breech Load Mortar Armament

Robotic Sensors

Projectile Recognition systems



Support Armaments Center

Automated Magazine for 120mm mortar





# 25mm Objective Sniper Weapon and Associated Recoil Considerations

---



Battelle –  
Jason Paugh

JSSAP –  
Steve Small,  
Ph.D.



## **BRIEFING AGENDA:**

**□ Introduction – Steve Small**

**□ SOF Sniper**

**□ Battelle Feasibility and Recoil Assessment**

**- Jason Paugh**

**Conclude – Steve Small**



# Special Operations Force (SOF) Sniper

## Object

- My purpose today is to present to you an unclassified tutorial on the several roles, and operational challenges of the Special Operations Forces (SOF) sniper
- And the underlying rationale for a 25mm “Payload” Sniper Weapon



## Special Operations Force (SOF) Sniper

# The Importance of Snipers

- During the Vietnam War U.S. Army snipers killed 1,245 of the enemy over a seven month period--with an average of 1.39 rounds per expended kill--this was at a time when hundreds of pounds of ordnance were employed to kill a few enemy soldiers.





## Special Operations Force (SOF) Sniper

# Sniper Applications

- Both the conventional and SOF snipers are warriors, and as such, their central mission--as shooters--is to kill enemy combatants and/or disable their equipment.
- Additionally, they are employed as the “eyes of the commander” and are gatherers of essential elements of information.



# Special Operations Force (SOF) Sniper



- The *SOF Sniper* is expertly trained in specialized techniques for the interdiction of leader-personnel or material targets
- His targets may be strategic/operational in nature



# Special Operations Force (SOF) Sniper

## Types of Sniper targets

- The two general categories of sniper targets are human and material
- For the conventional military and/or SOF sniper --dependent on distance--a head or chest shot is preferred



## Special Operations Force (SOF) Sniper

### Sniper Targets (cont.)

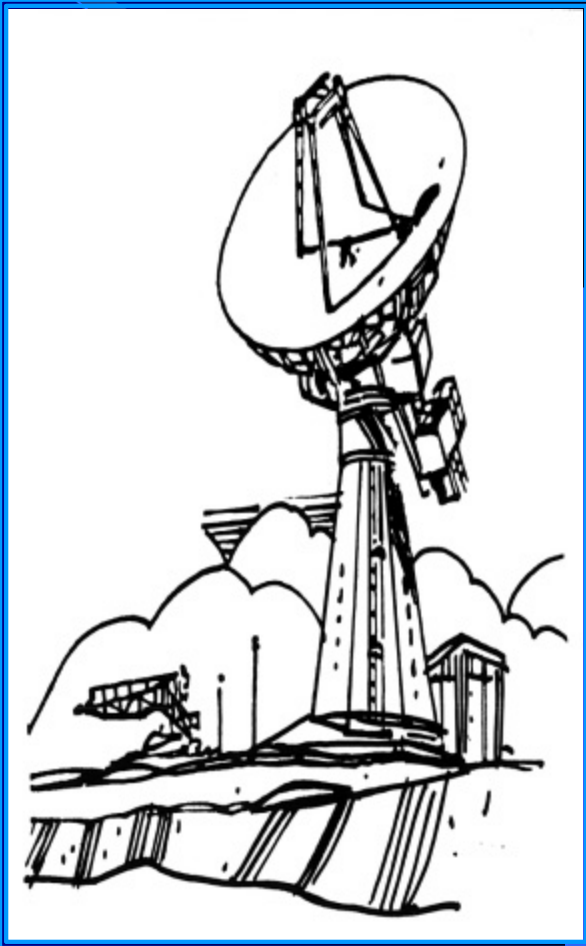
- Conventional military snipers tend to engage material targets of tactical importance, e.g. crew-served weapons.
- SOF snipers typically seek out HIGH-VALUE material targets, e.g. C4I SAR, equipment, SCUDs, etc.





# Special Operations Force (SOF) Sniper

## High Value Materiel Targets





# Special Operations Force (SOF) Sniper

## Summary

- SOF snipers are surgical weapons of war
- As such, they need responsive technologies to enhance their already substantial effectiveness
- The Barrett 25mm Objective Sniper Weapon is a unique “payload” gun designed specifically to interdict SOF material targets:
  - **C 4 I SAR**
  - **Support Facilities**
  - **Light Vehicles**
  - **Crew Served weapons**



B A R R E T T



# 25mm Objective Sniper Weapon Testing

- Test Setup
  - Weapons
  - Ammunition
  - Fixtures
  - Measurements
- Results
  - Recoil Study
  - Weaponneering Study
- Conclusions



Jason Paugh  
Battelle

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# Purpose of Tests

- Recoil Force Analysis
  - Measure peak recoil force and compare it to the .50 Caliber M82A1
- Dispersion Analysis
  - Evaluate shot dispersion with respect to the .50 Caliber M82A1
- Determine Lethality
  - Assess lethality with respect to the .50 Caliber M82A1



B A R R E T T



# Weapons Tested

Barrett M82A1  
.50 Caliber



Objective Sniper Weapon  
25mm



Barrett M82A1A

Barrett M82A1A	
<b>Length:</b>	57 inches (144.78 centimeters)
<b>Barrel length:</b>	29 inches (73.67 cm)
<b>Weight (Unloaded)</b>	32.5 pounds (14.75 kilograms)
<b>Bore diameter:</b>	12.7mm (.50 Caliber)
<b>Maximum effective range on equipment-sized targets:</b>	1800 meters
<b>Muzzle velocity:</b>	2795 feet (854 meters) per second
<b>Magazine capacity:</b>	10 rounds

25mm Objective Sniper Weapon

25mm Objective Sniper Weapon	
<b>Length:</b>	
<b>Barrel length:</b>	
<b>Weight (Unloaded):</b>	32.5 pounds (14.75 kilograms)
<b>Bore diameter:</b>	25 mm (0.98 inches)
<b>Maximum effective range on equipment-sized targets:</b>	TBD
<b>Muzzle velocity:</b>	1390 feet (424 meters) per second
<b>Magazine capacity:</b>	4 rounds



B A R R E T T

**Battelle**  
... Putting Technology To Work

# Ammunition

50 Caliber (Mk 211)

25mm (OCSW-TP)

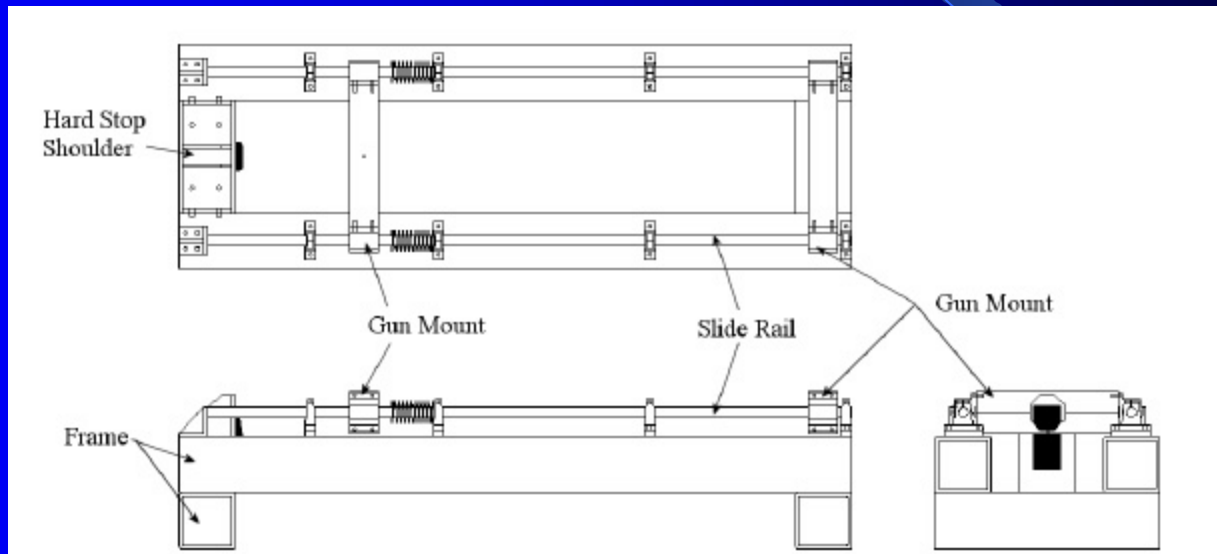


Weapon Data			General Data				Impulse Data				Energies	
Weapon	Caliber	Muzzle Brake Eff. (beta)	Chg. Wt. (lb)	Proj. Wt. (lb)	Proj Vel. (ft/sec)	Cham. Pres. (psi)	Total Imp. (lb-sec)	Imp.In-Bore (lb-sec)	Gas Imp. (lb-sec)	w/ Muz. Brake	Projectile Muz. Energy (ft-lb)	Projectile Muz. Energy (mJ)
<b>Small Arms</b>												
Barrett M82A1	50 cal	1.60	0.033	0.091	2795	55000	12.082	9.34	2.74	7.69	11047.76	0.0150
Objective Sniper Weapon	25mm	0.40	0.014	0.290	1390	32000	13.436	12.83	0.60	13.19	8707.12	0.0118

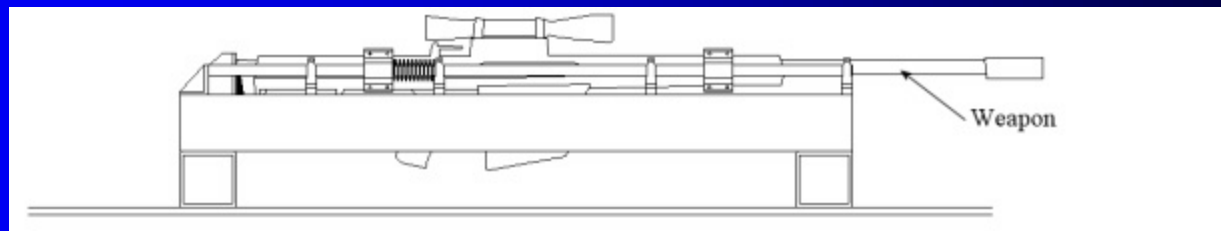


# Fixtures

- Hard Mount
  - Hard Mount Fixture

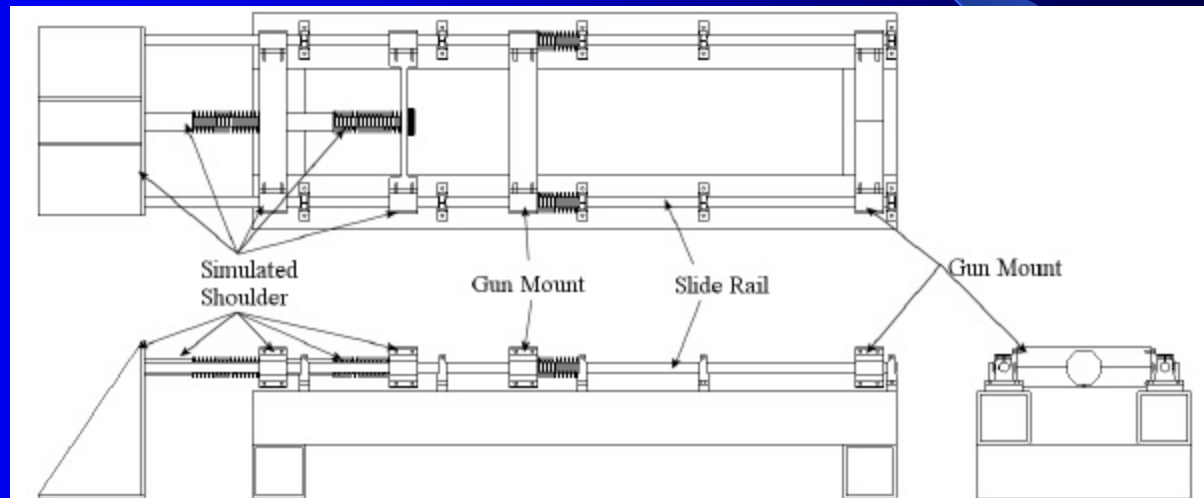


- Weapon mounted in hard mount fixture

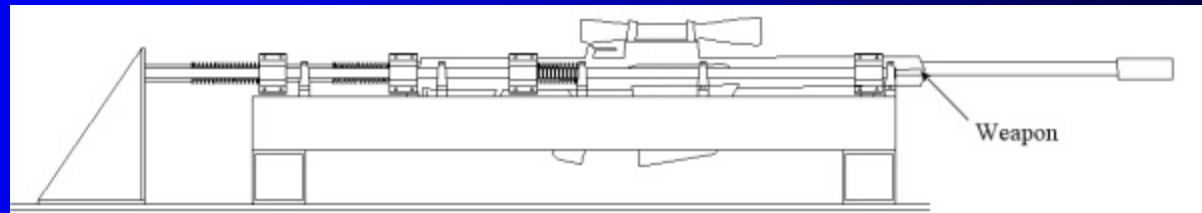


# Fixtures

- Simulated Shoulder
  - Simulates shoulder response in the standing or prone positions



- Weapon mounted in simulated shoulder fixture





# Measurements

- Transducers
  - Recoil Force Sensor
    - Placed behind the stock
    - Measures recoil force versus time
    - Measures peak recoil force seen by the shoulder
    - Placed normal to the recoil force vector
  - Linear Variable Differential Transducer (LVDT)
    - Measures shoulder displacement versus time





B A R R E T T



# Results

- Hard mount recoil testing
- Simulated shoulder recoil testing
- ATC Testing
- Weaponneering Study





# BARRETT

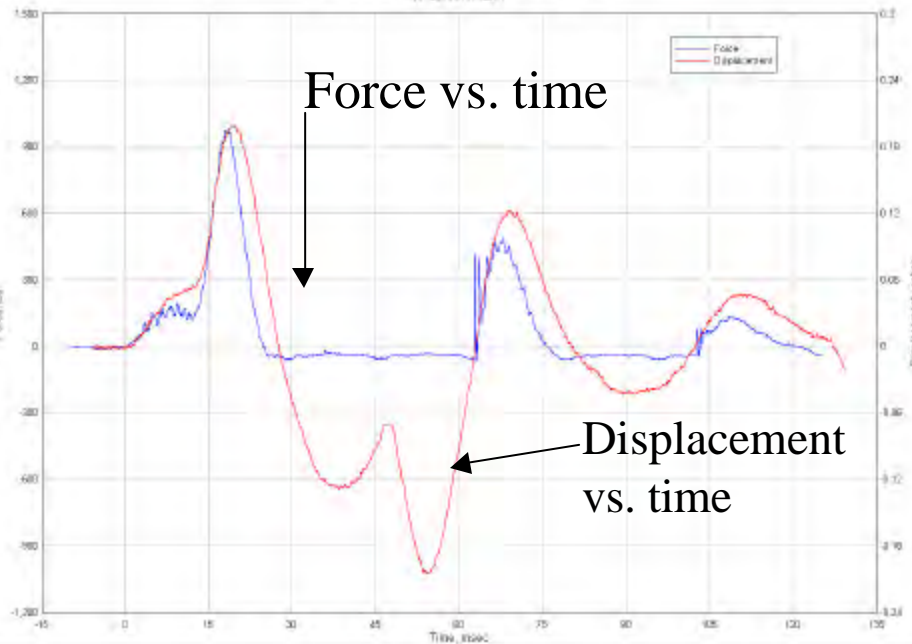
## Hard Mount Recoil Testing Results



### Barrett M82A1 .50 Caliber

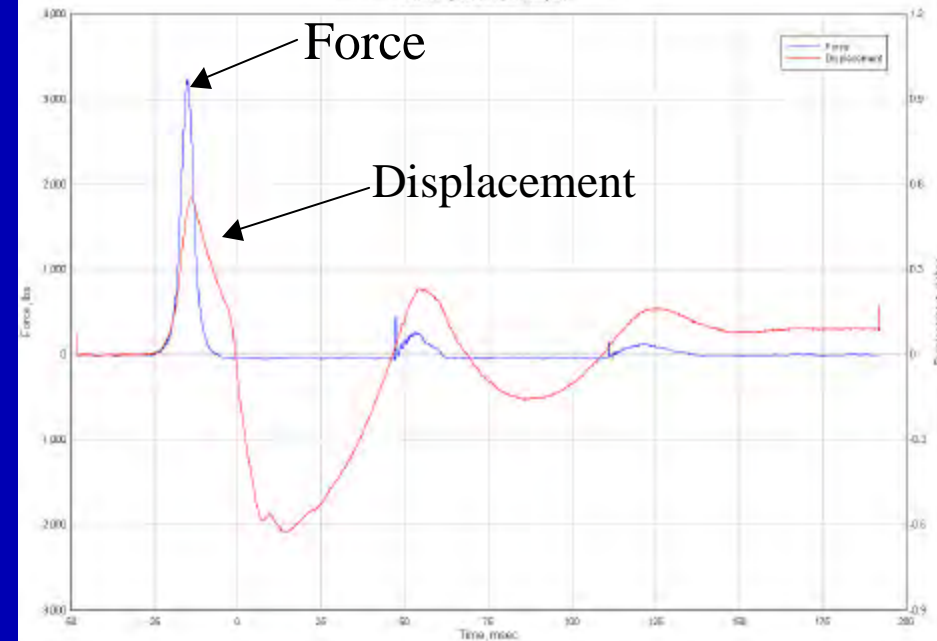
### Objective Sniper Weapon 25mm

Force and Displacement Versus Time  
50 Caliber M82A1



Peak Recoil Force: 975 lbs  
Projectile Velocity: 2724 ft/s  
Weapon Displacement: 0.20 inches

Force and Displacement Versus Time  
25mm Objective Sniper Weapon



Peak Recoil Force: 3240 lbs  
Projectile Velocity: 1418 ft/s  
Weapon Displacement: 0.55 inches



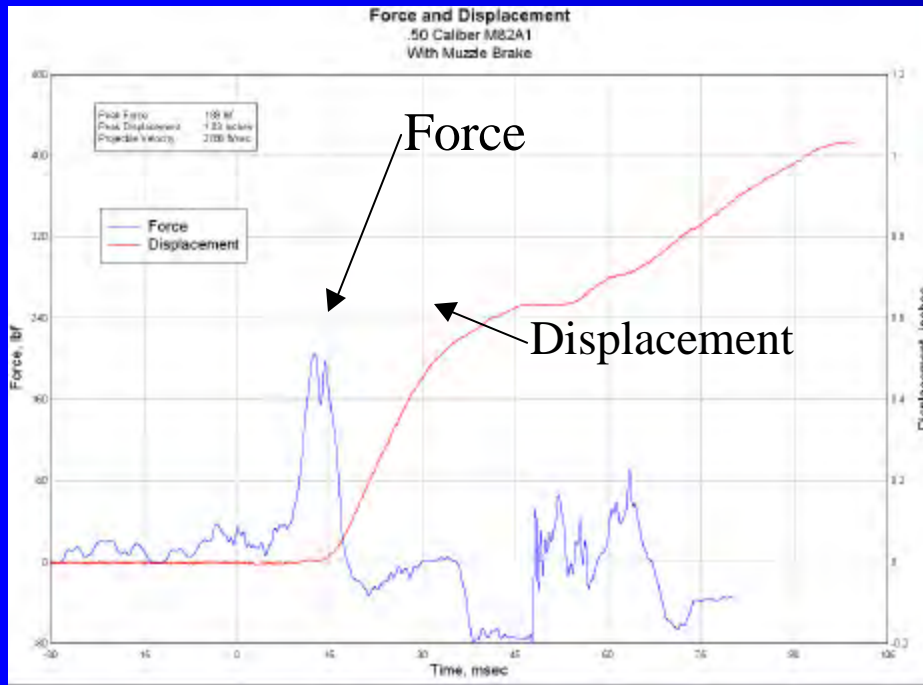
B A R R E T T

**Battelle**  
... Putting Technology To Work

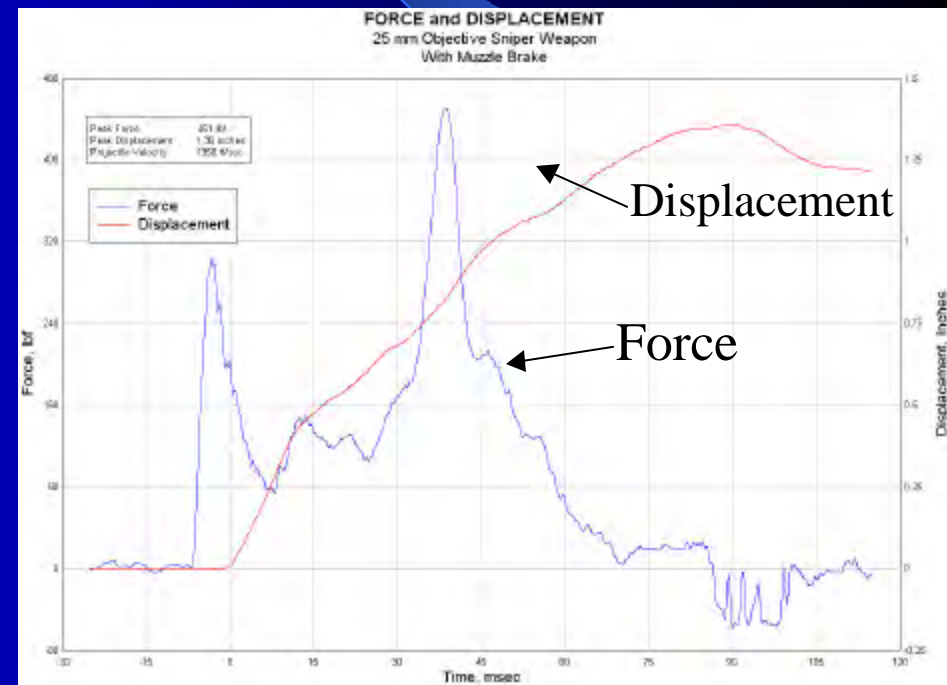
# Simulated Shoulder Recoil Testing Results

Barrett M82A1  
.50 Caliber

Objective Sniper Weapon  
25mm



Peak Recoil Force: 188 lbs  
Projectile Velocity: 2786 ft/s  
Shoulder Displacement: 1.03 inches



Peak Recoil Force: 451 lbs  
Projectile Velocity: 1358 ft/s  
Shoulder Displacement: 1.36 inches





# Recoil Testing Results

- Peak Recoil Comparison

	Measured Peak Force (lbs)
.50 Caliber M82A1 Hard Mount	975
.50 Caliber M82A1 Simulated Shoulder	210
25mm Objective Sniper Weapon Hard Mount	3240
25mm Objective Sniper Weapon Simulated Shoulder	451

The Peak Force Produced by the 25mm Objective Sniper Weapon is Considerably Larger than that of the .50 Caliber M82A1



# ATC Dispersion Testing

- Comparative Testing
  - Single Shot Test Barrel Using Mk 211 Ammunition
  - Single Shot Test Barrel Using 25mm TP OCSW Ammunition
  - M82A1 OTF2 (SN3629) Using Mk 211 Ammunition
  - Objective Sniper Weapon Using 25mm TP OCSW Ammunition
- Target Distances
  - 600 meters
  - 800 meters
- Five round groupings



B A R R E T T



# ATC Testing Results

Dispersion Testing				
Pooled Data of 10 Shots (2 Groupings of 5) (MoA)				
Range	Single Shot Test Barrel Using Mk 211 Ammunition (MoA)	Single Shot Test Barrel Using 25mm TP OCSW Ammunition (MoA)	M82A1 OTF2 (SN 3629) Using Mk 211 Ammunition (MoA)	25mm Objective Sniper Weapon Using 25mm TP OCSW Ammunition (MoA)
600 meter	.71	2.49	2.30	2.53
800 meter	1.34	2.76	2.74	3.33



## Weaponneering Study

- Determine if the 25mm Objective Sniper Weapon is able to reduce the number of rounds it takes to disable a known target by a factor of three
- Targets
  - BMP-3
  - Big Bird Radar
- Range
  - 600 meters
  - 800 meters







# Weaponneering Study

- Approach
  - BRL-CAD
    - Determine the vulnerabilities of a known target
    - Calculate the shot line needed to impact vulnerabilities
  - COVART
    - Used BRL-CAD target and shot line models
    - Used ATC dispersion data
    - Determined the destructive capabilities of each round



B A R R E T T



# Weaponneering Study

- Summarized Results

- Big Bird Radar

- At 600 meters each weapon required the same number of rounds to disable the target.
    - At 800 meters the Objective Sniper Weapon required half as many rounds as the .50 caliber M82A1.

- BMP-3

- At 600 meters the .50 caliber M82A1 required 2.5 times more rounds than the Objective Sniper Weapon.
    - At 800 meters the .50 caliber M82A1 required 2 times more rounds than the Objective Sniper Weapon.

In both cases the, Objective Sniper Weapon had greater lethality than the .50 caliber M82A1.



# Weaponneering Study

- Summarized Results
  - The Objective Sniper Weapon can accurately engage a target with three rounds fired in thirty seconds
  - Engaged targets within 3 minutes at 600 meters.
  - Engaged targets within 4 minutes at 800 meters.



B A R R E T T



# Conclusions

- The concept is feasible
  - Free recoil energy can be reduced
    - Lowering the velocity of the round
    - Increasing the mass of the weapon
  - Peak force can be reduced
    - Weapon design update

The weapon provides greater lethality at range





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# Special Operations Force (SOF) Sniper

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Lethality, Survivability, Mobility and  
Sustainment for America's Army

# **The NATO Armaments Ballistic Kernel**

## **Ballistics Software Available for Small Arms and Mortar Fire Control**

**16 May 2002**

**André J. Sowa \***

**John H. Whiteside**

**Firing Tables and Ballistics**

**\* Presenter**

U.S. Army TACOM-ARDEC

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[whitesid@pica.army.mil](mailto:whitesid@pica.army.mil)

**2002 International Infantry & Joint Services Small Arms Systems Section Symposium, Exhibition & Firing Demonstration  
International Infantry Session**



# The NATO Armaments Ballistic Kernel

Ballistics Software Available for Small Arms and Mortar Fire Control

# N A B K

**NATO**

**Armaments**

**Ballistic**

**Kernel**

**Gun Fired  
Spin Stabilized  
and  
Fin Stabilized  
Projectiles**

**Solves  
the  
Gunnery  
Problem**

**Software**



**Aerodynamic Performance Characterization**

**Guidance and Control**

**Delivery Accuracy**

**“On Time, On Target” with Ballistic Expertise and Aiming Data Products**

**Testing Design, Planning, and Oversight**

**International Standards Ammunition Interchangeability Sharable Software**

**Trajectory Simulation and Ballistic Performance Analysis and Prediction**

**GUN ORDERS QE AZ FS**

**MET**

**C.G.**

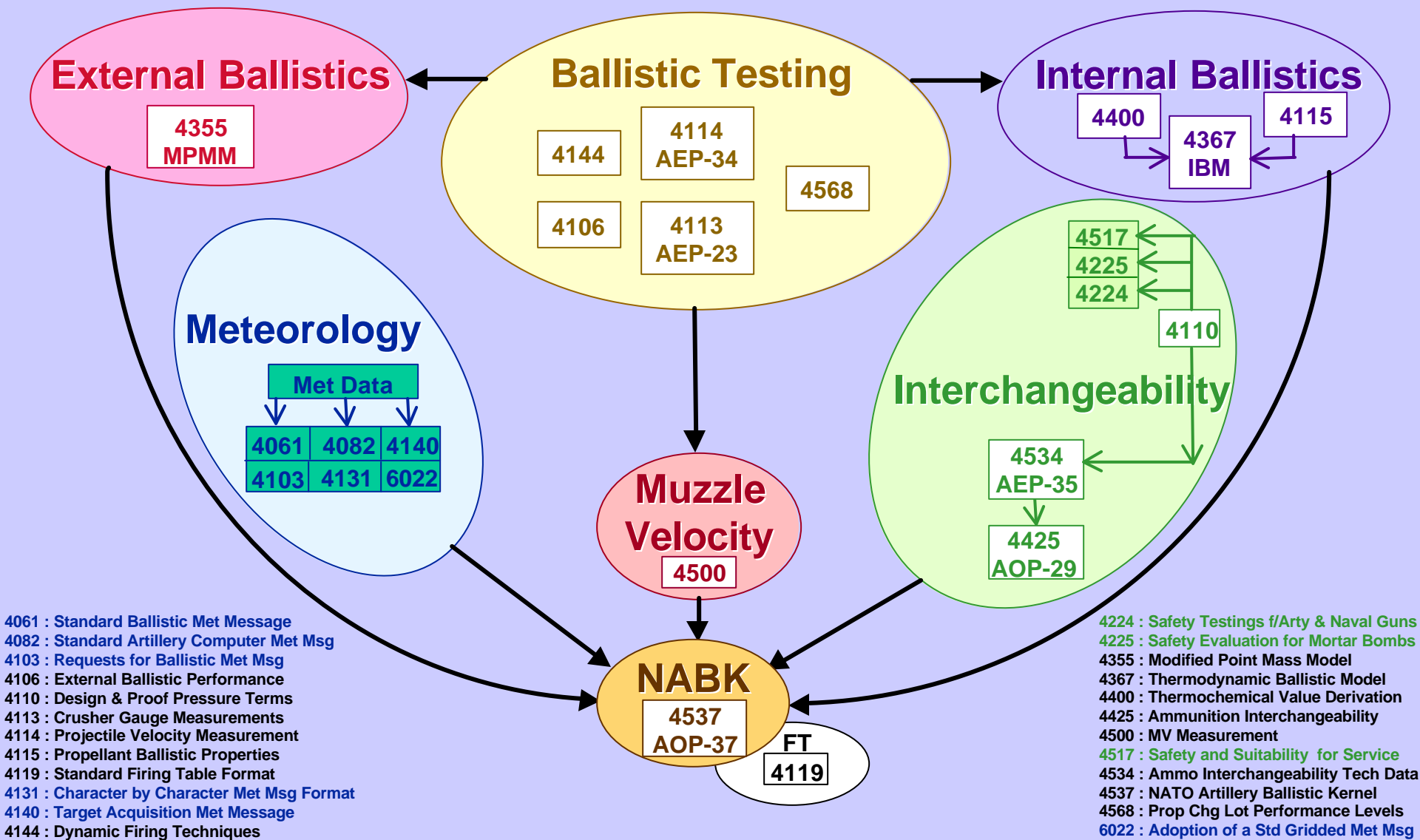
**C.G.**

**16 May 2002 3/17**





# Supporting Standardization Agreements





# What does the NABK do?

- Anything that requires knowledge of trajectories or is related to ballistics
- Trajectory simulation
- Computes gun orders
- Charge selection
- Muzzle velocity management
- Calculates and selects registration corrections
- Includes fire support coordination measures that require trajectory information (e.g. near crest, far crest, and ACA locations)

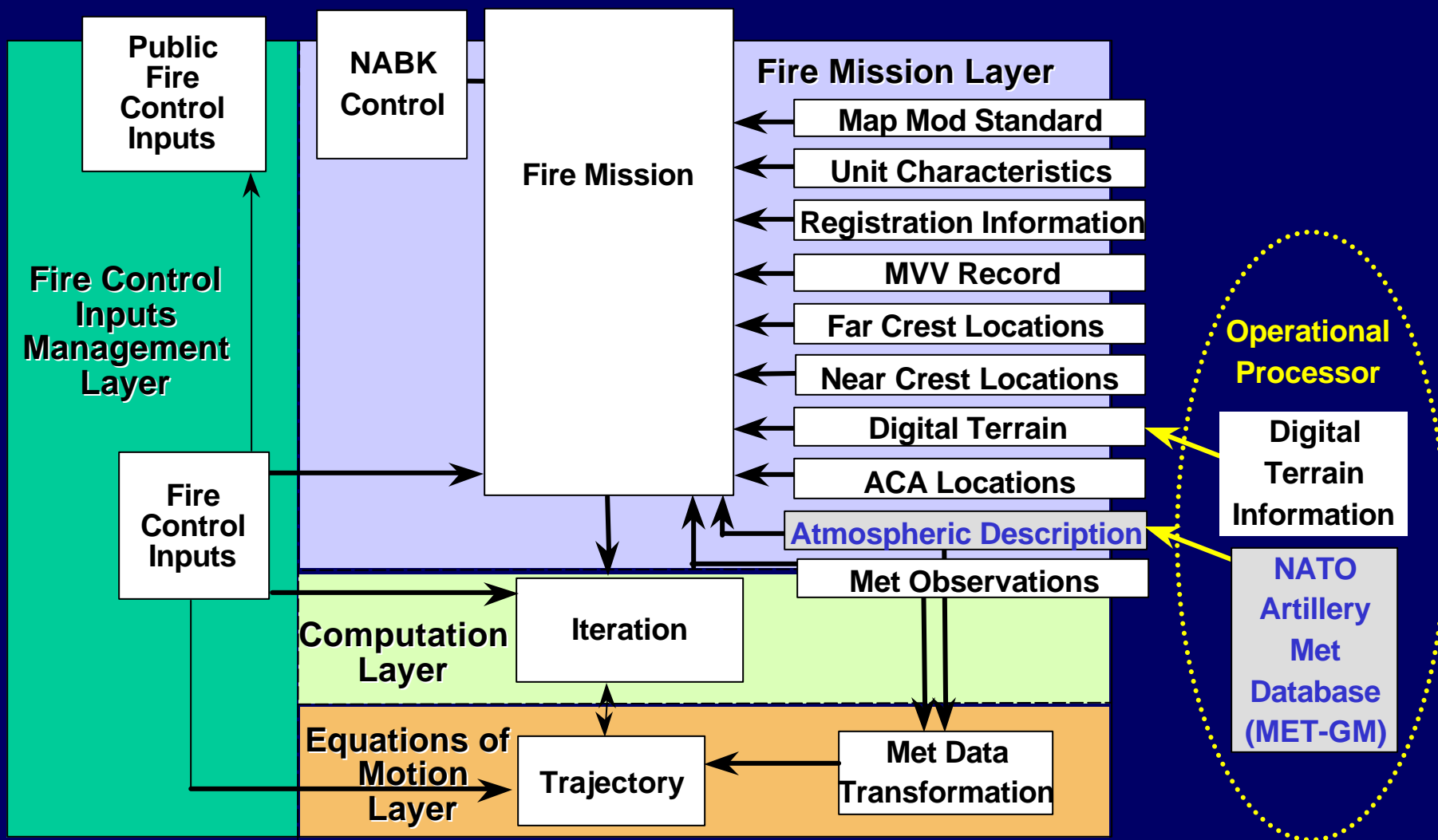


# What does the NABK NOT do?

- Ammunition selection
- Effectiveness calculations
- Fire support coordination measures that do not require trajectory data (e.g. no fire areas)
- Does not know target details just aim points
- Does not know about locations of forward observers
- Does not have its own interfaces to digital communication equipment (info is passed by OPr)



# NABK Software Architecture





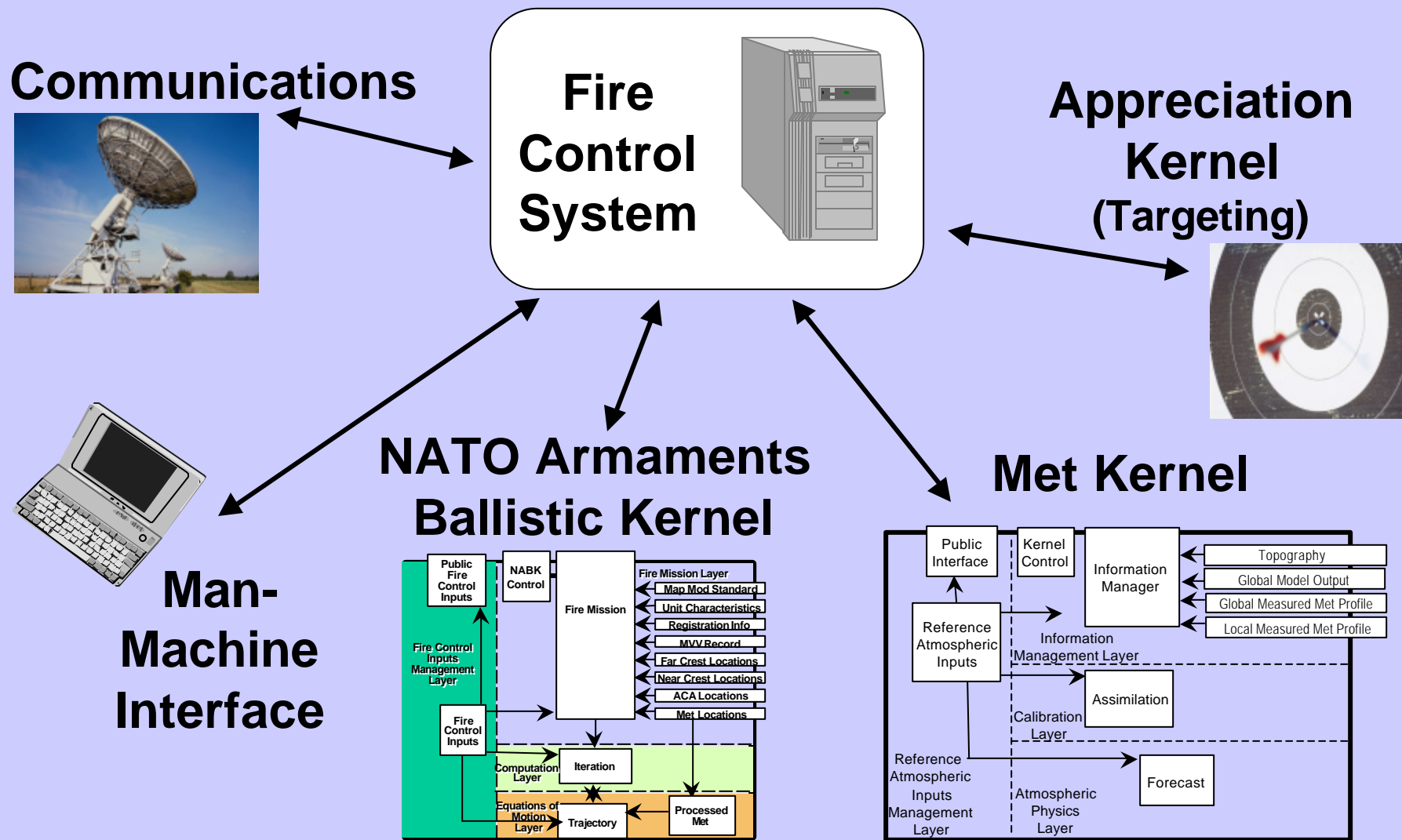


## **Developers**

- **International development effort under the auspices of the NATO Army Armaments Group AC/225 Land Group 4, Sub-Group 2 on Ballistics**
- **Current countries involved**
  - ❖ Belgium, Canada, Denmark, France, Germany, Italy, Netherlands, Norway, Poland, Turkey, United Kingdom, United States
- **Procedures being proposed to include participation by Partners for Peace through NATO member country sponsorship**



# Sharable Fire Control Software Kernels





## **Rationale for Program**

- **To significantly reduce or eliminate duplication of effort by standardizing the implementation of NATO ballistic technology**
- **To avoid significant expenditure of time and money in future development and updates of ballistic fire control software**
- **To ensure accuracy and reliability**
- **To establish a common method to facilitate the use of NATO ammunition interchangeability**
- **To develop a single software package that is reusable across multiple weapon systems**



# Development Process

- **Program guidance (STANAG 4537) established**
- **Software development plan established and maintained**
- **Key areas managed:**
  - ❖ Requirements, Technology, Database Development, Software Development, Configuration Management, Quality Assurance, Policy
  - ❖ Peer review integral to each area
- **Program documentation (AOP-37 and source documents) established and maintained**
- **Overall program review initially held every 4 months, now every 6 months; appropriate persons in each key area communicate and meet as required**





## **Key Design Goals**

- **Plan, design and engineer the code for safety and reuse**
- **Develop the software in the Ada95 programming language**
- **Allow Fire Control Inputs data to be updated without modifying source code**
- **Accommodate each country's Fire Control Inputs and the implementation of AOP-29**
- **Make the software configurable without modifying source code**
- **Check all input for correctness; verify the integrity of the Fire Control Inputs**



## Current Status

- Software releases:

<u>Version</u>	<u>Release Date</u>	<u>Meets U.S. Rqmts for:</u>
1.0	Sep 98	Dragon Fire Demo
1.0+	Dec 98	Paladin V11
1.1	Feb 99	
1.5	Jul 99	Crusader, MK 92
1.6	Sep 99	
1.63	Apr 00	AFATDS-99
2.0	Sep 00	
3.0 Beta	Jul 01	
3.02	Dec 01	AFATDS-99+/V7, Paladin V7
4.0 Beta	Release scheduled for Jul 02	
5.0	Release scheduled for Feb 03	

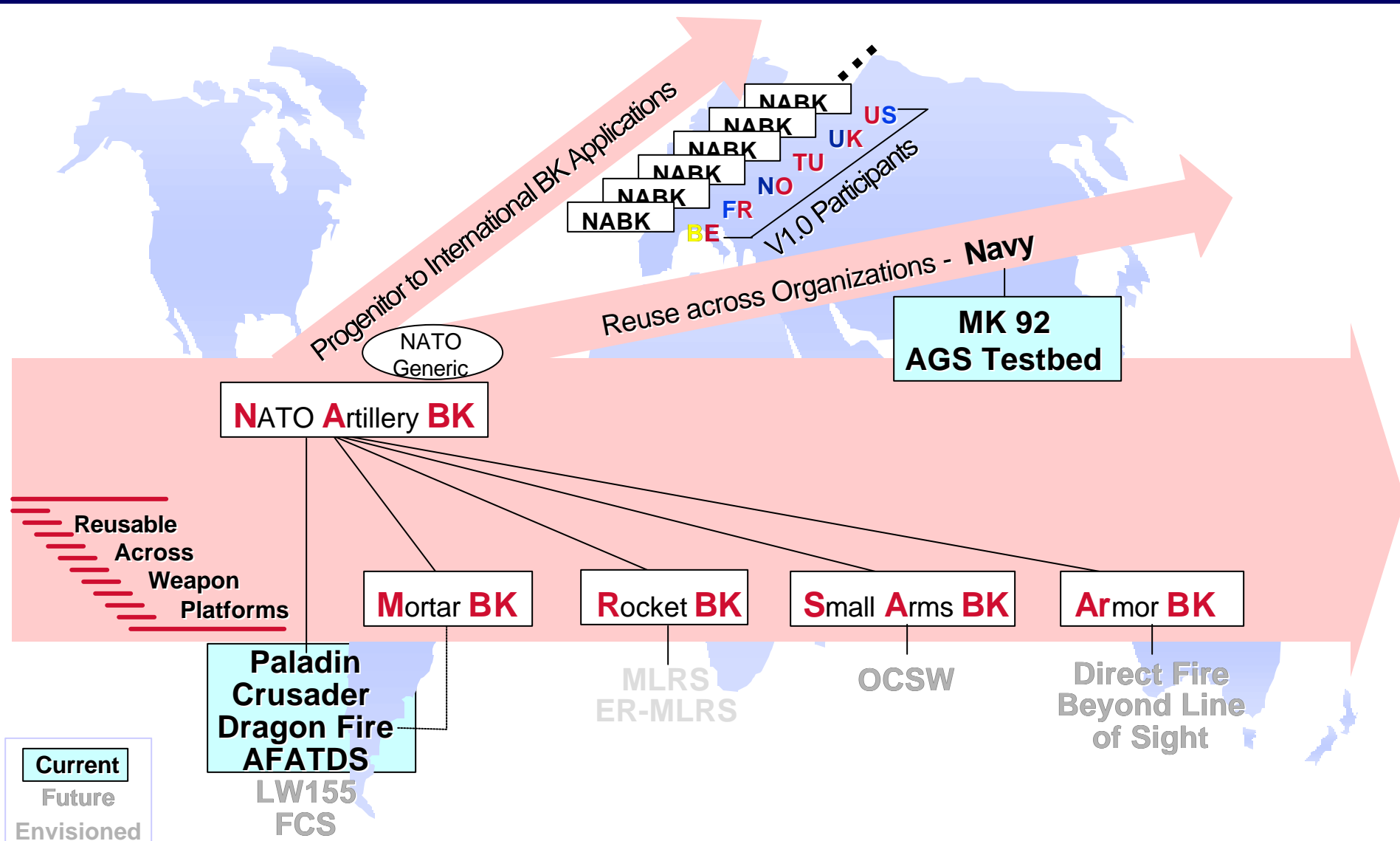


## National Implementations

- 12 countries currently participating in the continued development and maintenance effort
- 19 current implementations in 8 countries
- 32 future implementations being worked in 12 countries
- 3 different compilers being used: Aonix, GNAT, Rational



# U.S. Applications of NABK Software







# Controls on Information

- Program guided by STANAG 4537 and documented in the associated AOP-37 and source documents
- All NATO member nations can implement the NABK into their national weapon systems
- Appropriate contractors must formally agree and adhere to non-disclosure and non-use criteria
- Only participating NATO member nations can sell a product containing the NABK (executable code)
- Procedures are being proposed to include participation by Partners for Peace through NATO member country sponsorship



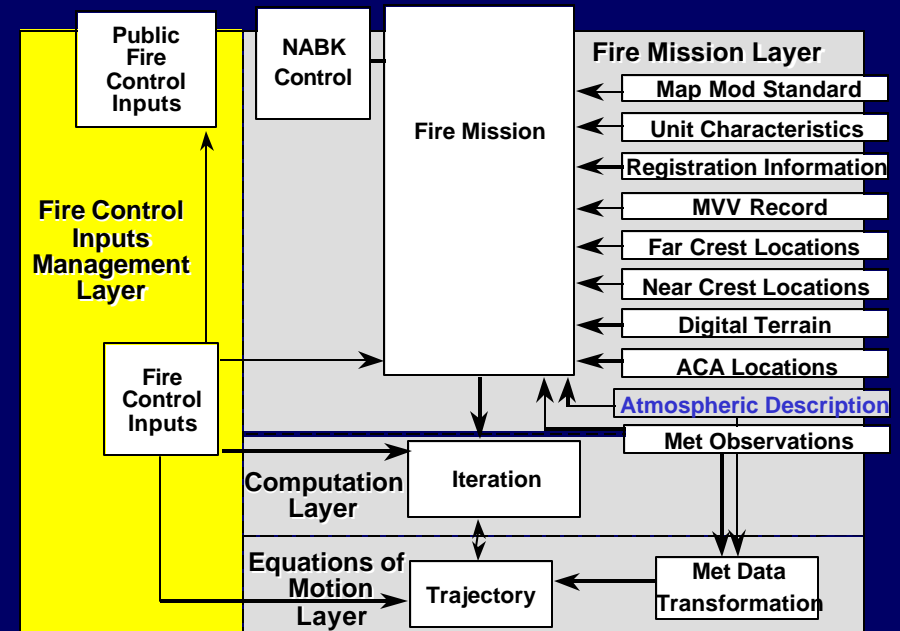
## Summary

- The NABK standardizes the implementation of NATO ballistic fire control technology in a reusable and sharable product
- Reliability is ensured through extensive code and safety criticality review, testing, and product use
- The NABK provides for horizontal integration across weapon systems
- The NABK contains the necessary physics and algorithms to “shoot” mortar and small arms ammo; development of FCI databases and test tools required
- Life cycle maintainability and cost avoidance are being realized



# Fire Control Inputs Database Layer

- Contains pertinent projectile and weapon data
  - aerodynamic coefficients
  - physical characteristics (caliber, weight, moments of inertia, etc.)
  - probable error data
  - propulsion characteristics
  - payload characteristics
  - fuze data
  - interchangeability data
- ASCII file or embedded Ada code
- Accessed by all layers
- Portion accessible to other fire control system configuration items which require data such as
  - legal wpn/proj combinations
  - maximum and minimum range data
  - probable error data





# Equations of Motion Layer

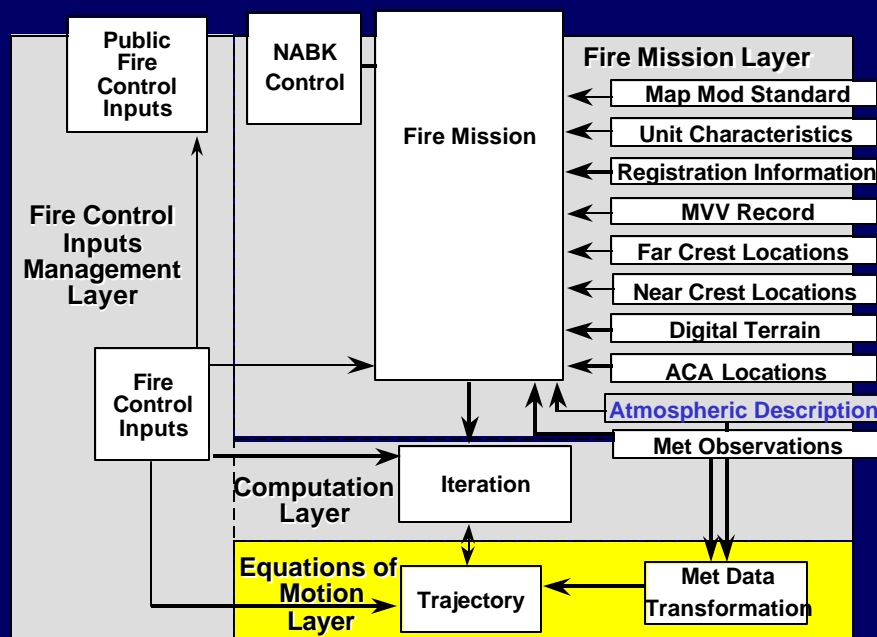
- Single trajectory simulation

- Input:

- Azimuth
- Elevation
- Muzzle Velocity
- Gun position
- Meteorological conditions

- Output:

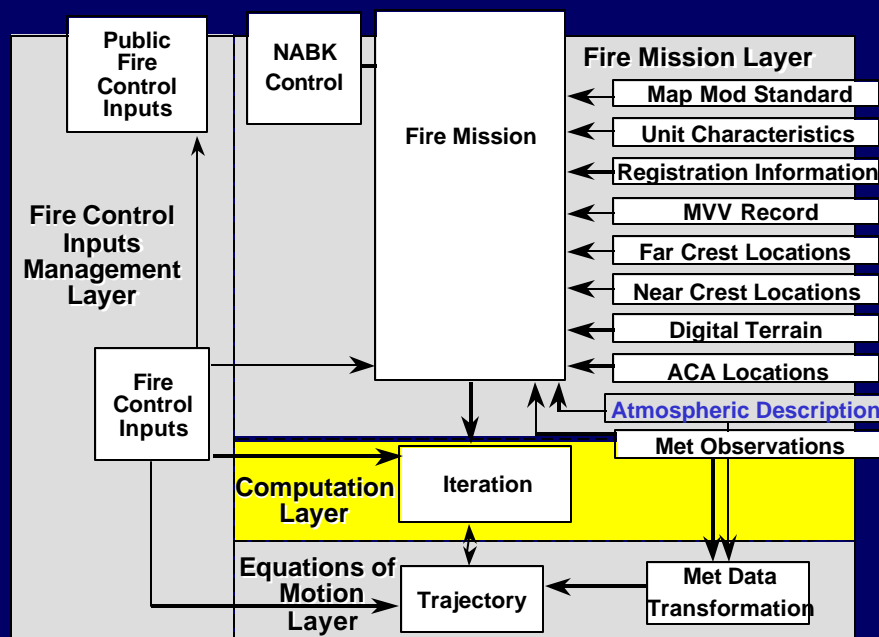
- Impact or fuze function point
- Time of flight
- Trajectory flight path







# Computation Layer

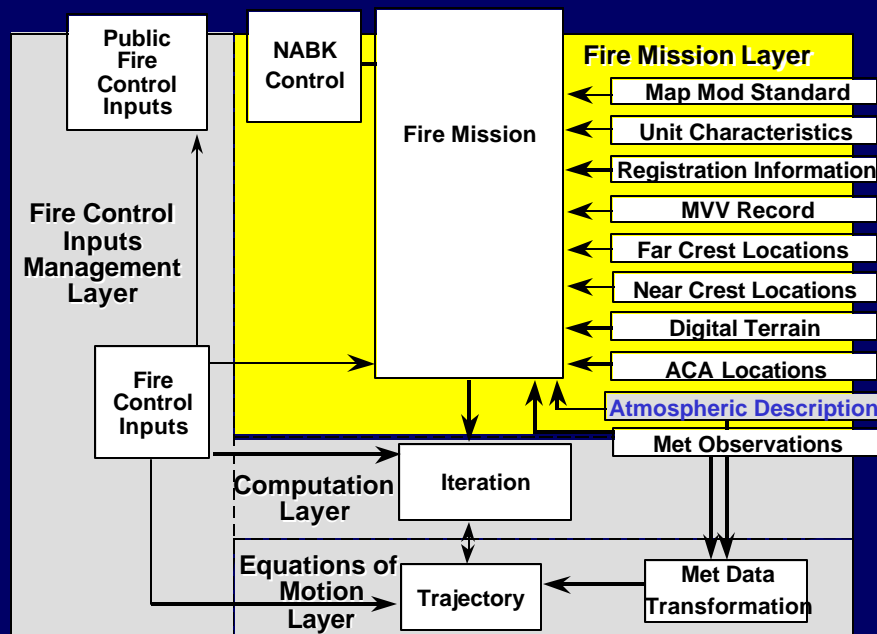


- Communicates with equations of motion layer
- Iterates on azimuth and elevation to converge on a trajectory solution to hit desired target(s)
- Solutions generated for low angle or high angle fire



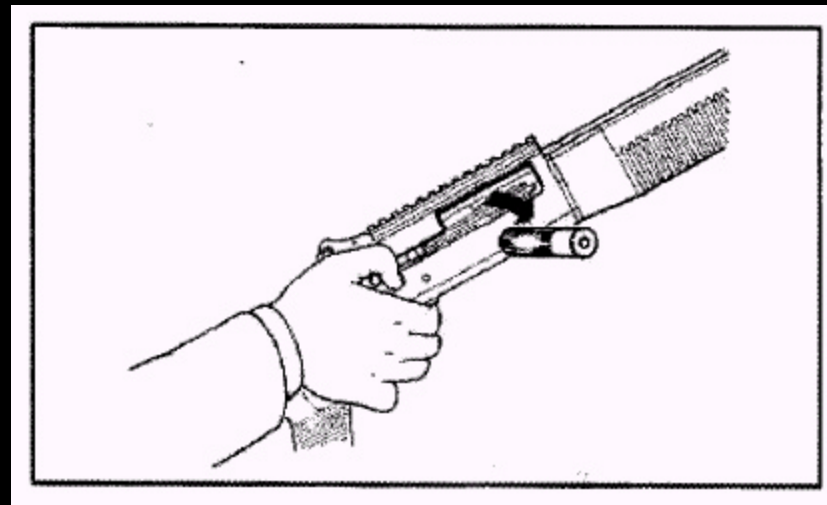
# Fire Mission Layer

- Bridge between technical ballistics and operational procedures
- Interface to operational processor
- Access to all databases
- Input is a set of aimpoints
- Charge selection
  - Made by input from operational processor or
  - Selected using predefined criteria
- Accounts for MVV and registration correction data and performs checks for air corridor and crest violations
- Governs computational processing of each fire mission
- Can handle a number of fire missions concurrently





## Balance of Power



JSCS 12-GA Point Control Feasibility Study

Presentation By: Shawn Spickert-Fulton



Most riot control actions occur at a distance of less than 40 ft.





## *12-GA M1014 Shotgun Feasibility Study*

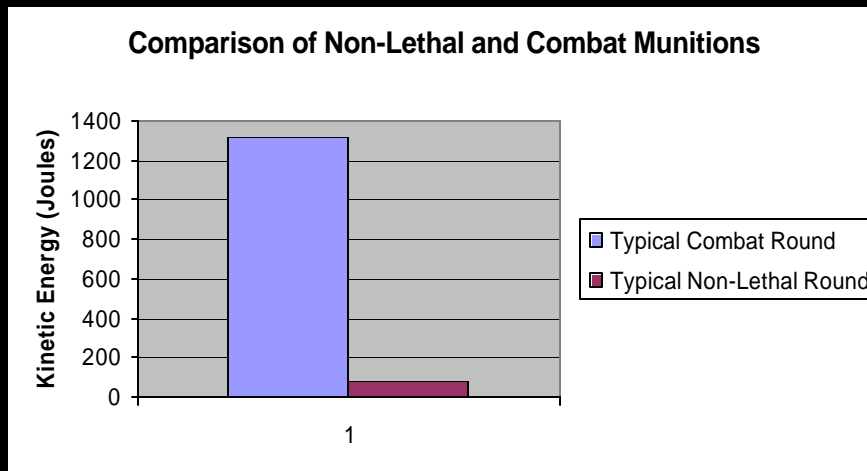


### ● Purpose:

To investigate the development of a cost-effective, 12-gauge non-lethal point control blunt trauma cartridge that can be routinely and effectively fired semi-automatically from the M1014 Joint Service Combat Shotgun with no detrimental effects to the weapon or operator.



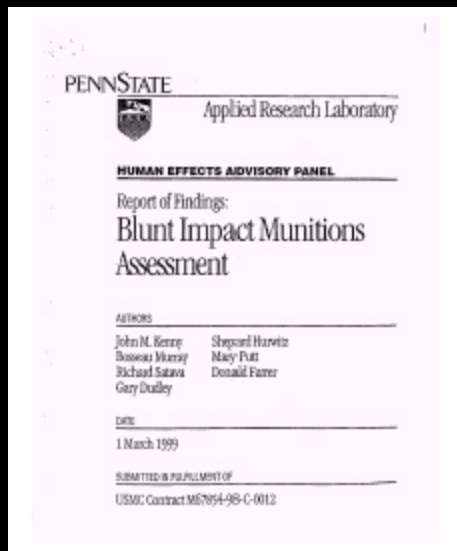
# The Problems



- Lethal vs. Non-Lethal Ammunition Characteristics
- M1014 JSCS Characteristics
- Targets and Operating Conditions



# Determination of Lethality



- Clay Deformation
- Ballistic Gelatin
- Three Rib Model
- Other (Finite Element, VC, Sturdivan, etc)



## *Project Objectives*

- Explore definition of “non-lethal”
- Develop common kinetic energy test criteria for 12-GA non-lethal munitions
- Conduct commercial feasibility studies for cycling non-lethal rounds semi-automatically through the joint service combat shotgun
- Conduct in-house research to complement commercial findings



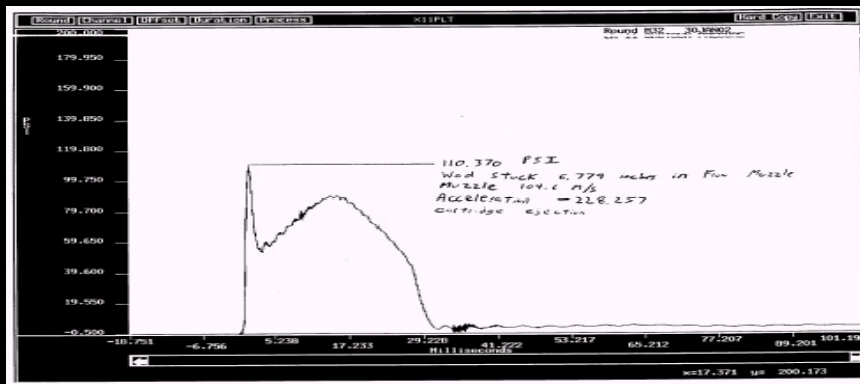


# *Program Metrics*

- Define non-lethal parameters
- Obtain interested commercial developers and researchers
- Establishment of baselines for semi-automatic functionality
- Conduct tests on modified munitions
- Conclusions and recommendations



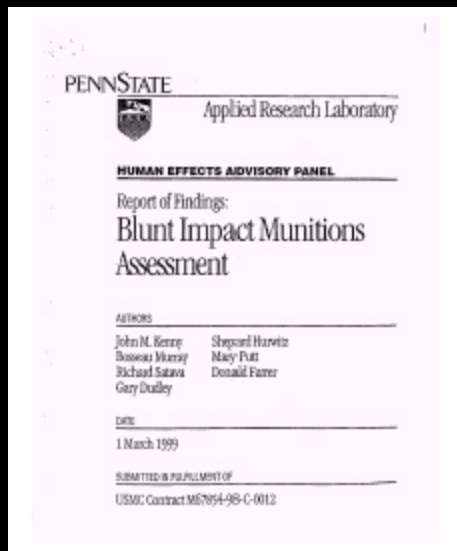
# Basic Weapon Cycling



- Aberdeen Analysis
- Picatinny Analysis
- Commercial Industry Analysis



# Determination of Lethality



- Clay Deformation
- Ballistic Gelatin
- Three Rib Model
- Other (Finite Element, VC, Sturdivan, etc)



# Concept Explorations

- Parasitic Mass
- Increased Aerodynamic Drag
- Projectile Material Variations
- Projectile Construction Variations
- Propellant Alterations and Chemical Additives





# Preliminary Findings

- No COTS at this time
- Prototypes show promise but have issues which need to be explored and resolved further.
- Lethality criteria is very subjective and is likely to remain so. However, there is some consensus growing in certain areas.



## *On-going Activities*

- American System Corporation is analyzing the data from the sub-contractors
- ARDEC lab trials are being conducted at ATF
- Final report & meeting scheduled for end of May



## Acknowledgements

American System Corporation

Defense Technologies

TSG Ammo

National Institute of Justice

ATG (Aberdeen Proving Grounds)

TACOM ARDEC

# **Joint Non-Lethal Weapons Program (JNLWP)**

## **Update to 2002 Int'l Infantry & Joint Services**

### **Small Arms Section Symposium**



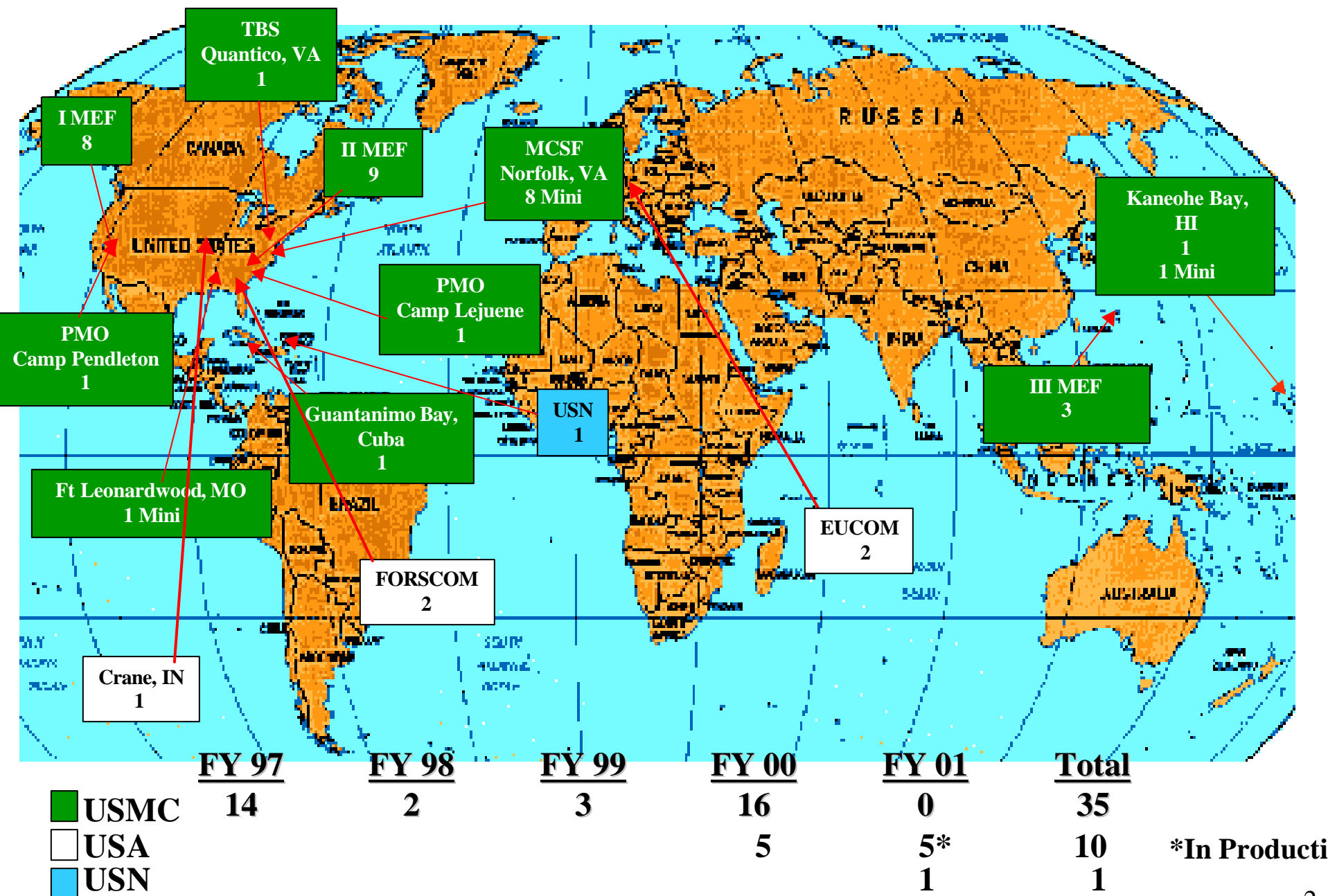
**Kevin Swenson**

**DSN 278-3049, Ext. 229 or (703)784-3049, Ext 229**  
**swensonkj@jnlwd.usmc.mil**

**Joint Non-Lethal Weapons Directorate**  
**3097 Range Road**  
**Quantico, Virginia 22134-5100**



# Fielded NL Capability Sets





# Joint Integration Program

- 12 Guage Flash-Bang Assessment
- RCA Dispenser Comparison Tests
- Ammunition Characterization Tests
- Lightweight Shotgun System Feasibility
- NL Ammunition Test Roadmap
- Ammunition Effectiveness Endurance Testing
- Launch Cup Completion
- Training Suit / Strike Bags
- Fire Safety Equipment



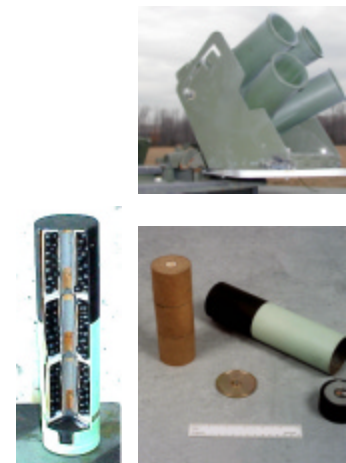


# Acquisition Programs

**Modular Crowd Control Munition (MCCM)**



**66mm Vehicle Launched NL Grenades (VL NLG's)**



**Portable Vehicle Arresting Barrier (PVAB)**



**40mm Non-Lethal Crowd Dispersal Cartridge (NLCDC)**

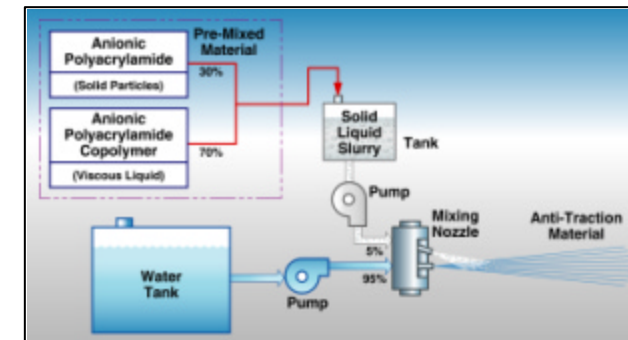






# Mobility Denial System (MDS)

- **Man Portable System**
  - 5 gallons, reaches 20 feet & covers 2,000 Sq. Ft.
- **Vehicle Transportable System**
  - 300 gallons, reaches 100 feet & covers 120,000 Sq. Ft.
- **Acquisition Objective – 472 MP Systems & 47\* Vehicle Transportable Systems**
- **PM – Captain (USMC) Warren, COM (703)784-2006, Ext. 42733**



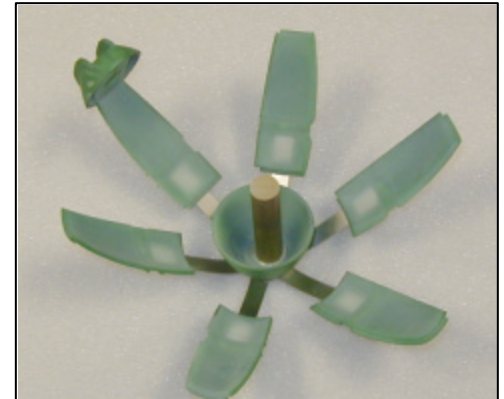
\* Quantity of USA VT Systems TBI





# Clear A Space Status

- **Distract / Disorient Space Occupants**
- **FY02 Effectiveness Analysis Ongoing**
  - **ORD Values (MoP's & MoE's)**
  - **Define Entry Time Requirements by Service / CINC**
  - **Effects Duration Requirement varies by Service / Agency – 5 mnute minimum**
  - **Define “Disorient” & “Incapacitate” from a CAS Human Effects Perspective**
  - **Mk 141 Flash Bang Grenade used as Baseline Capability**
- **Additional FY02 Activities: Req. Development, TEA, SBIR, CONOPS, Tech. Roadmap**
- **Tailored Executive Analysis (TEA) Considerations:**
  - **MSG (SBIR), Thermobarics, Stun & Flameless Grenades, Pepper Sprays, etc...**
  - **Hand Thrown or Shotgun Launched**





# Concept Exploration

**Area Denial to Personnel (USA)**



**Clear Facilities (USMC)**



**Crowd Control (USA)**



**Area Denial to Vehicles (USA)**



**Incapacitate Pers. (USMC)**



**Area Denial to Boats (USN)**







# Other Tactical Programs

(Requirements Pending)

- **Mk 19 40mm NL Munition**
- **OICW - NL Round**
- **NL Mortar Munition**
- **Running Gear Entanglement System**





# Advanced Concept Technology Demonstrations (ACTD's)

## Advanced Tactical Laser



**FY 01 New Start**

CINC Sponsor: USSOCOM

Joint Sponsor: JNLWD

Technical Mgr: USA (SMDC)

Operational Mgr: AFSOC

## Active Denial System



**FY 02 New Start**

CINC Sponsor: JFCOM

Joint Sponsor: JNLWD

Technical Mgr: USAF (AFRL)

Operational Mgr: ACC

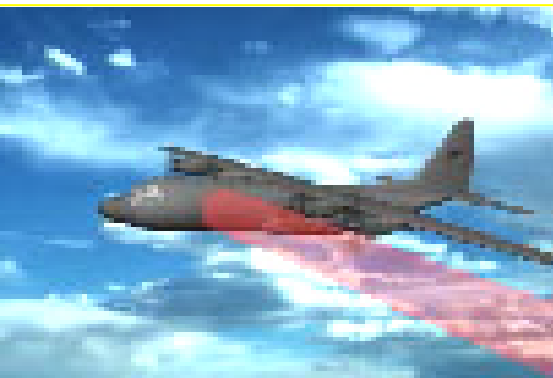




# Other JNLWP

## Transformational Capabilities

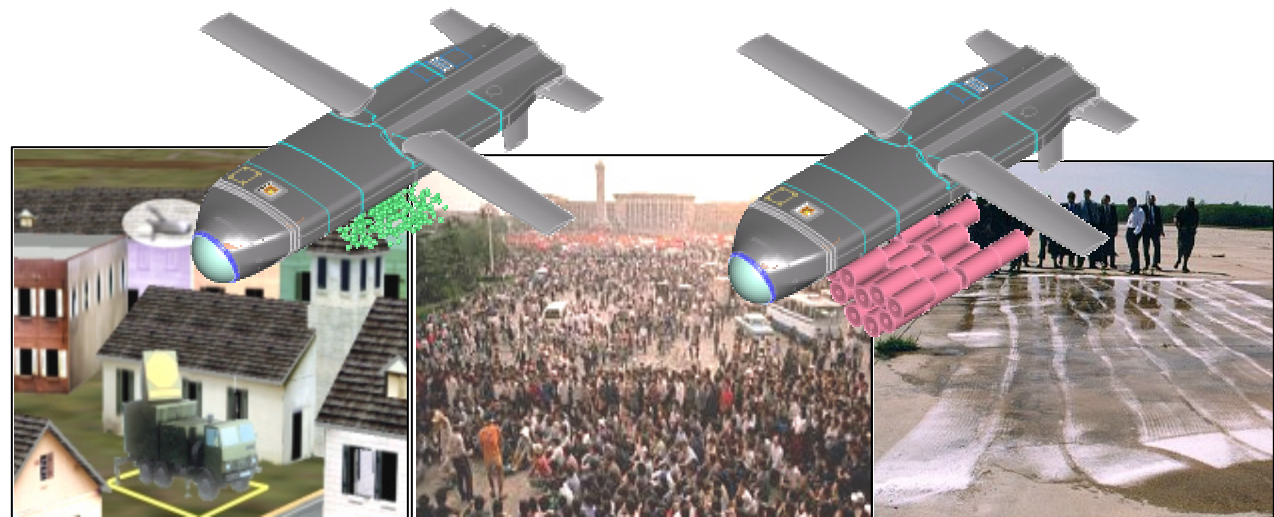
### Airborne Active Denial



### Pulsed Energy Projectile



### Long Range Delivery





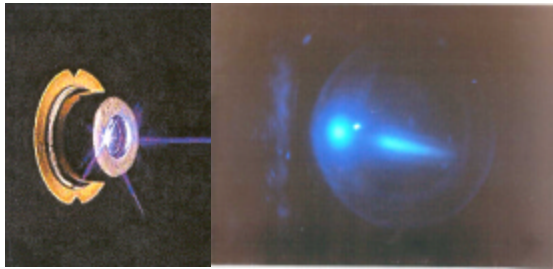
# Technology Investment Projects

**Due Date**



**Thermobaric Tech. (USN)**

**3QFY02**



**Veiling Glare Laser (USAF)**

**3QFY02**



**Front End Analysis of RCAs (USA)**

**3QFY02**

**FY03 TIP BAA – Crowd Control & Area Denial to Personnel  
- UGV's, NL APM's, 40mm & 12 Gauge Systems**



# NLW Lessons Learned

- **Requirements Generation:**
  - **USMC** – Universal Need Statement (UNS) Requirement
  - **USA** – Two to Three Year ORD Development & Coordination Timeline
- Develop Service Integrated Concept Teams
- Human Effects Characterization
- Legal / Acceptability / Environmental Impacts
- DoD Versus DoJ Requirements
- Fire from Existing Platforms
- Address Interoperability
- Consider Evolutionary Acquisition Proposals
- Focus on Payload, not the Launching Platform

# **Small Arms Fire Control System II Overview**



**NDIA 2002 International Infantry & Small Arms Symposium**



**Brashear LP  
615 Epsilon Drive  
Pittsburgh, PA 15238**



## Vision/Introduction

- *It is our vision to provide to the American Fighting Force the finest combat systems available to defeat the enemy with nothing less than complete success for the soldier on the battle field.*
- Brashear LP (BLP) is a small, lean and technologically powerful company committed to the development and fielding of superior small arms fire control systems.
- The leader in Individual & Crew Served (I&CS) Small Arms Fire Control programs for the past ten years, BLP has accumulated more experience in this product area than any other company.



## SAFCS II Program

- Next fire control system development program under the Office of the Program Manager for Small Arms (OPMSA), Picatinny Arsenal, NJ
- Contract was awarded to Brashear LP on 10 September 2001
  - Contract number: DAAE20-01-C-0123
  - Performance based specification
- Provides an improved fire control system for Mk19 Mod 3 GMG
- Delivery of 20 units for type classification starting November 2003
- Type classification in 2004
- Production options available for 1750 units

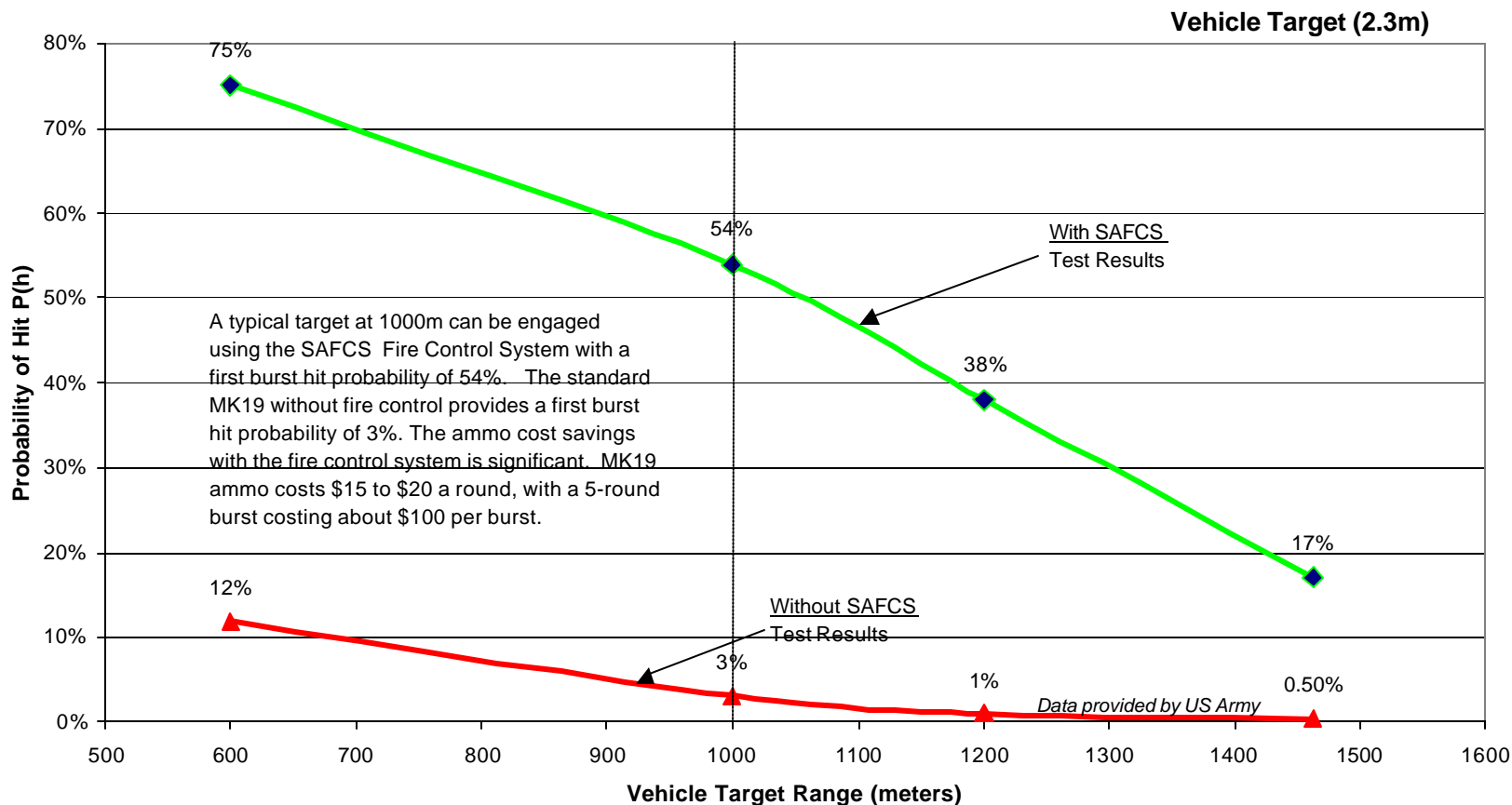


## Key Features

- Class 1 eye safe solid state laser range finder
- High resolution video day sight
- Internal Un-cooled thermal imager night sight
- Programmable ballistics computer
- Remote operation capability
- Multiple display options (Land Warrior interface)
- Fuse setting for air burst munitions
- Environmental sensor suite
- Optional power sources (battery or vehicle power)
- Designed for rugged military use per MIL-STD 810 and MIL-STD 461

*Readily adaptable for multiple crew-served weapons and applications*

## MK19 First Burst Probability of Hit Results Small Arms Fire Control System (SAFCS)

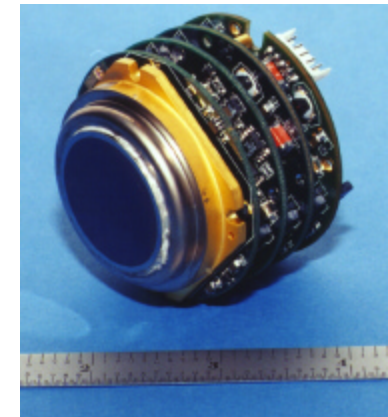
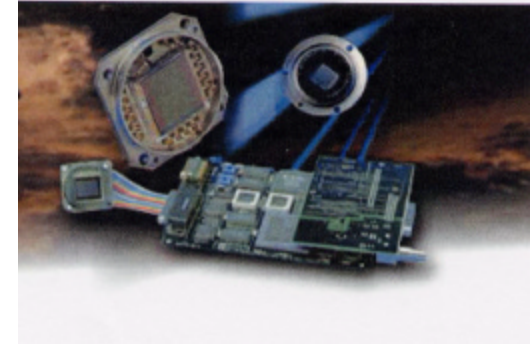


***Demonstrated Vastly Improved First Burst Probability of Hit at 1000 meters***



## Cutting Edge Thermal Technology

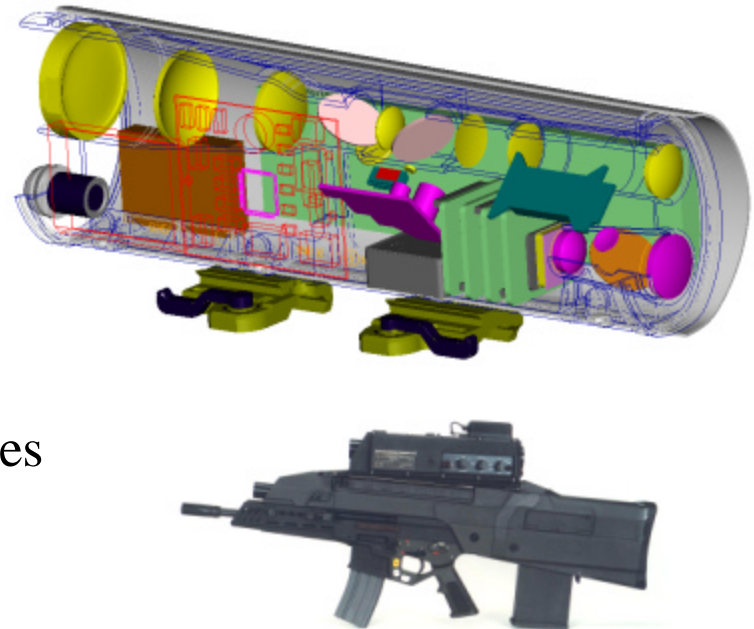
- SAFCS II Night Sight Key Features
  - 320 x 240 25 $\mu$ m pixel uncooled microbolometer
  - 8 to 12  $\mu$ m spectral band responsivity
  - 50mK or better sensitivity
  - F/1.3
  - 5° diagonal FOV
  - 114 mm effective focal length
- Range discrimination performance
  - Recognition of a vehicle-sized target at 2000 m
- Benefits of small format microbolometer
  - Smaller IR optics
  - Lower weight
  - Lower power consumption
  - Lower cost due to both commercial and military applications



*An unrivaled capability to dominate the 21<sup>st</sup> Century Battlefield*

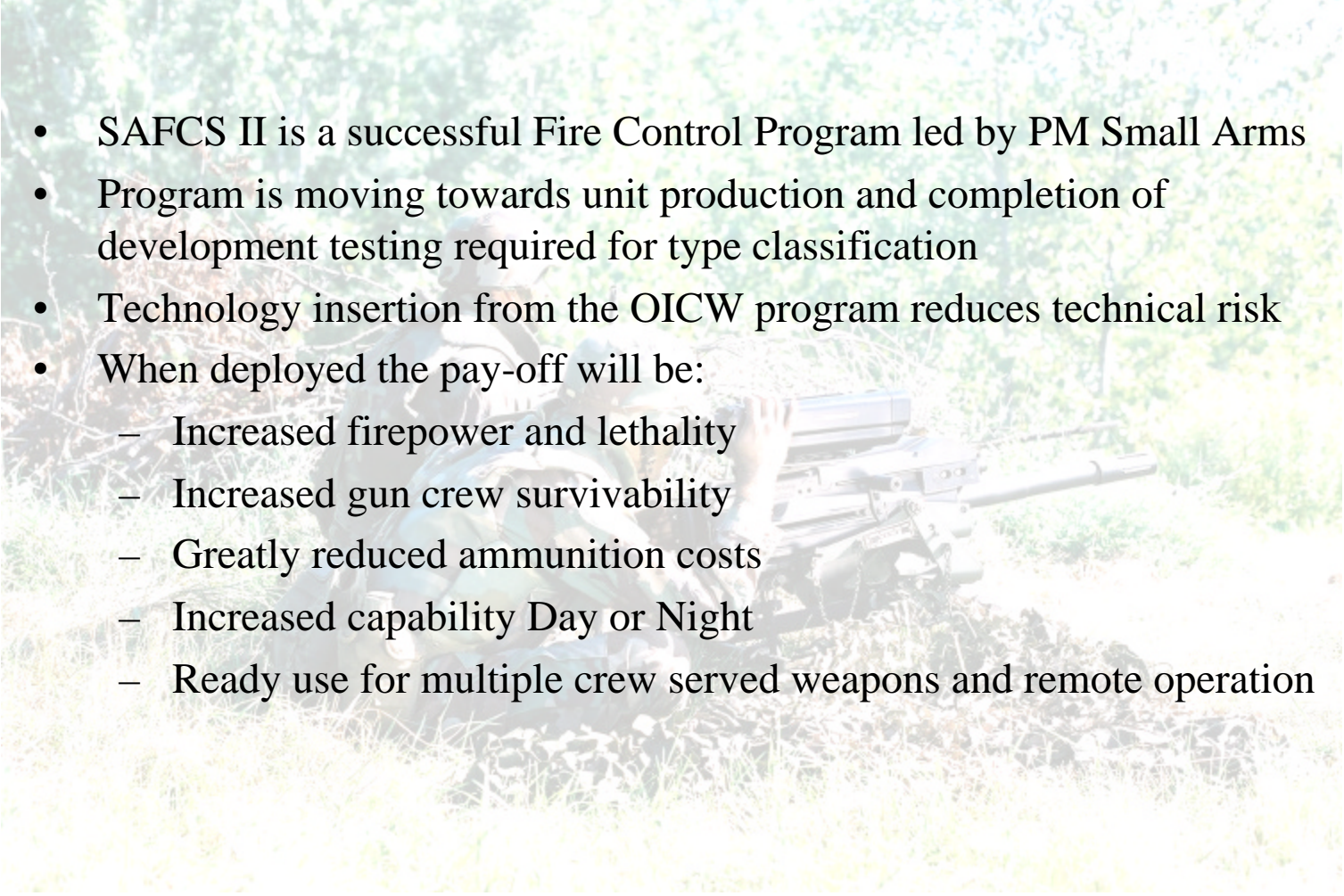
## Synergy with OICW TA/FCS

- Technology insertion from OICW TA/FCS reduces SAFCS II program risk
  - Thermal
  - Laser range finder
  - Displays
  - Housing materials
  - Electronics
  - Ergonomics
- Commonality with OICW TA/FCS reduces acquisition and support costs



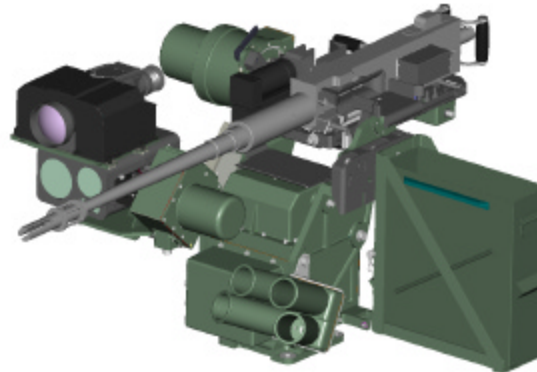
*SAFCS II Will Leverage on Common Design Philosophy to OICW TA/FCS*

## Summary

- 
- SAFCS II is a successful Fire Control Program led by PM Small Arms
  - Program is moving towards unit production and completion of development testing required for type classification
  - Technology insertion from the OICW program reduces technical risk
  - When deployed the pay-off will be:
    - Increased firepower and lethality
    - Increased gun crew survivability
    - Greatly reduced ammunition costs
    - Increased capability Day or Night
    - Ready use for multiple crew served weapons and remote operation

# Common Remotely Operated Weapon Station (CROWS)

National Defense Industrial Association  
**SMALL ARMS SYSTEMS SYMPOSIUM**  
Atlantic City, NJ



**15 May 2002**

Mr. Chester Topolski  
CROWS, PD / OPM Small Arms  
Picatinny Arsenal, NJ 07806

Mr. George Hines  
Recon Optical Inc.  
Barrington, IL 60010



# Common Remotely Operated Weapon Station (CROWS)

## Purpose

- To provide a technical description of CROWS
- To present initial results from testing performed at Aberdeen Proving Ground this year
- To summarize planned follow-on testing



# Common Remotely Operated Weapon Station (CROWS)

## OPM Small Arms Mission

- Management from 6.4 through Production for:
  - Individual and Crew Served Weapons
    - Pistols
    - Shotguns
    - Rifles
    - Machine Guns
    - Carbines
    - Grenade Launchers
  - Optics & Fire Control that are weapon mounted
  - Ammunition & Grenades; Lethal and Non-Lethal
- Oversight for Integration of all items that claim real estate on small arms platforms



**OPM SA is the material developer for CROWS**



# Common Remotely Operated Weapon Station (CROWS)

## Overview / Benefits

- Manufactured by Recon/Optical Inc., Barrington, IL
- Proponents: US Army Military Police School and US Air Force Security Forces Center
- Approved ORD Apr 99, projected FUE in late FY04
- Capable of serving as the primary or secondary armament system on a variety of vehicle platforms
  - Integrated and tested on UA HMMWV M1116
  - Efforts ongoing to integrate onto UA M1114 and Armored Security Vehicle (ASV) M1117
- Replaces the manual crew served vehicle mount or turret
  - Permits under armor/remote operation of existing crew served weapons for suppression of ground troops and engagement of light armor enemy vehicles
  - Allows for protection against enemy fire and munition fragmentation
- Increased survivability for gunners on lightly-armored platforms
- Increased lethality (ability to engage targets at greater distances with the initial burst)

**CROWS on UA HMMWV M1116, USAF**



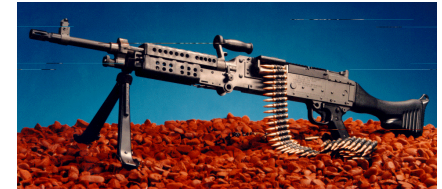
**ASV M1117, US ARMY**



# Common Remotely Operated Weapon Station (CROWS)

## System Description

- Weapons supported
  - MK19 GMG
  - .50 Cal M2HB MG
  - M249 SAW
  - Planned weapon capability
    - M240B MG (by Sep 02)
  - Growth potential to other weapons
- Weapons can be interchanged, as required by the user
- Two axis stabilized mount enhances on the move target acquisition, tracking and engagement
- Ability to track targets independent of gun motion (in elevation)
- Electronic Fire Control System increases first round hit probability
- Sensor suite permits target engagement under day and night conditions at up to the maximum effective range of weapons



M240B, 7.62 mm Machine Gun



M249 Automatic Rifle/Light  
5.56 mm Machine Gun



.50 Cal M2HB



MK19 40 mm GMG



# Common Remotely Operated Weapon Station (CROWS)

## System Characteristics

- |  |                           |
|--|---------------------------|
| - Ammo ready round capacity:                     | Mk19-96, M2-300, M249-400 |
| - Manual/emergency back-up operation             |                           |
| - Programmable non firing zones in azimuth       |                           |
| - Stabilized, allowing accurate fire on the move |                           |
| - Traverse                                       | Continuous 360°           |
| - Range of Elevation                             | + 60° to -20°             |
| - Azimuth Rate (adjustable)                      | 90° /s                    |
| - Elevation Rate                                 | 60° /s                    |
| - 2 Cradles (heavy and light)                    |                           |
| - Total Weight                                   | < 450 lb                  |
| - Height to Top of Weapon                        | < 30 inches               |

# Common Remotely Operated Weapon Station (CROWS)

## Sensors

### Day Sight



**High-Performance,  
Extended Range Day Sensor**

Identification range, vehicle	2,200 m
Field of View (zoom)	1.1° - 28.8°
Focal Length	256.5 - 9.5 mm
Magnification	0.5X to 8.5X

### Laser Range Finder

**Determination of Vehicle Range:  
5,000 m  $\pm$  10m**

### Night Sight

**Heavy Thermal  
Weapon Sight (HTWS)**

Recognition Range, Vehicle	2,200 m
Wide FOV	9° x 5.4°
Narrow FOV	3° x 1.8°
Spectral Range	3-5 $\mu$ m



# Common Remotely Operated Weapon Station (CROWS)

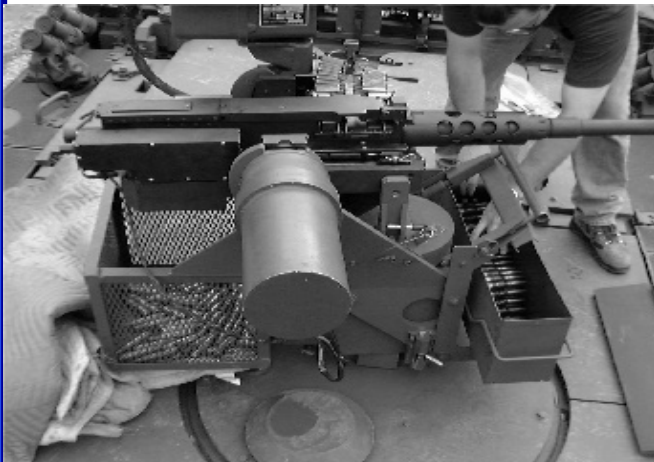
## Vehicle Integration

### Common Elements

EFCS Sensor w/  
Day Sight,  
LRF & I2

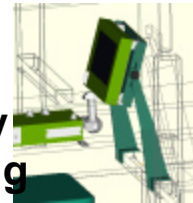


Mount

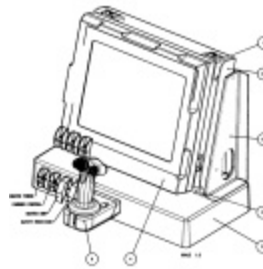


### Vehicle Specific

Display  
Mounting



Operator  
interface



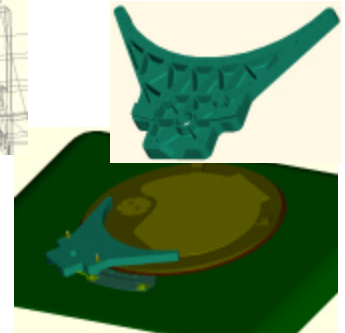
Removable  
Joystick



Cables



Mount  
Interface



# Common Remotely Operated Weapon Station (CROWS)

## Achieved Performance (CROWS on Hardstand)

	STAB	RANGE	ZERO	# OF	BURSTS	BURST	# RDS	
GUN	ON?	TO TGT (M)	RANGE (M)	EVENTS	PER EVENT	SIZE (RDS)	PER EVENT	# OF RDS ON TARGET PER EVENT
M249	NO	800	800	10	1	10	10	8, 10, 9, 9, 9, 10, 10, 10, 10, 10
M2	NO	1000	1000	6	2	10	20	5, 1, 2, 1, 2, 1
MK19	NO	1000	1000	10	2	5	10	0, 2, 2, 3, 2, 0, 0, 2, 2, 1
M249	YES	800	800	6	1	10	10	9, 10, 10, 10, 10, 20
M2	YES	1000	1000	9	1	10	10	5, 5, 2, 6, 6, 4, 1, 1, 6
MK19	YES	1000	1000	5	2	5	10	2 HITS
M249	YES	800	300	5	1	10	10	9, 9, 8, 6, 8
M2	YES	1000	300	5	1	10	10	7, 4, 2, 3, 3
MK19	YES	1000	300	0	0	0	0	NONE FIRED

Demonstrated that with a good fire control, CROWS can provide good performance



# Common Remotely Operated Weapon Station (CROWS)

## Achieved Performance (Vehicle)

### CROWS ON STATIONARY VEHICLE (TARGET SIZE 2.3M X 2.3M)

#### (M1116 UP ARMORED HMMWV)

	STAB	RANGE	ZERO	# OF	BURSTS	BURST	# RDS	
GUN	ON?	TO TGT (M)	RANGE (M)	EVENTS	PER EVENT	SIZE (RDS)	PER EVENT	# OF RDS ON TARGET PER EVENT
M249	YES	800	800	7	1	10	10	9, 6, 6, 7, 8, 8, 6
M2	YES	1000	1000	5	1	10	10	1, 2, 3, 1, 1
MK19	YES	1000	1000	5	1	10	10	1, 2, 0, 2, 1

### CROWS ON VEHICLE MOVING AT 15 MPH (TARGET SIZE 2M X 3M)

#### (M1116 UP ARMORED HMMWV MOVING OVER CROSS COUNTRY TERRAIN)

	STAB	RANGE	ZERO	VEHICLE	# ROUNDS	3 ROUNDS
GUN	ON?	TO TGT (M)	RANGE (M)	MOTION	FIRE	ON TARGET
M249	NO	500	500	CLOSING	20	11
M249	NO	500	500	AWAY	10	5
M249	YES	500	500	CLOSING	50	22
M249	YES	500	500	AWAY	30	7

# Common Remotely Operated Weapon Station (CROWS)

## Additional Tests Performed

- Measurement of Dispersion

- Hardstand/Vehicle
- Stabilized/Un-stabilized
- Different ranges
- Hot, ambient and cold

- Environmental effects

- Temperature
  - Hot (140 °F)
  - Cold (-25 °F)
- Vibration
- Shock
- Rain

- **M249**

- 800 rounds  
Zeroed at 300m,  
Fired at 850m, 8X8 target,  
**90%+ hit rate**

- **Mk-19**

- 350 rounds  
Zeroed at 300m,  
Fired at 1000m, 18X20 target,  
**70%+ hit rate**

- **M2HB**

- 2000 rounds  
Zeroed at 300m,  
Fired at 1000m, 18X20 target,  
**70%+ hit rate**

- **All firing was off vehicle**

# Common Remotely Operated Weapon Station (CROWS)

## Videos from Live-fire Demo



# Common Remotely Operated Weapon Station (CROWS)

## Planned Follow-on Tests

- Engineering tests (on-going)
  - Acquire additional data
  - Define system performance at longer ranges, under variety of moving scenarios and at temperature extremes
- ASV Integration (Jul 02)
  - Assess performance of CROWS on ASV platform under a variety of test conditions
- Developmental Testing (Oct 02)
  - 4 month duration
  - Formal testing to permit independent evaluator to assess system performance against COIC and ORD requirements
- Operational Testing (Jul 03)

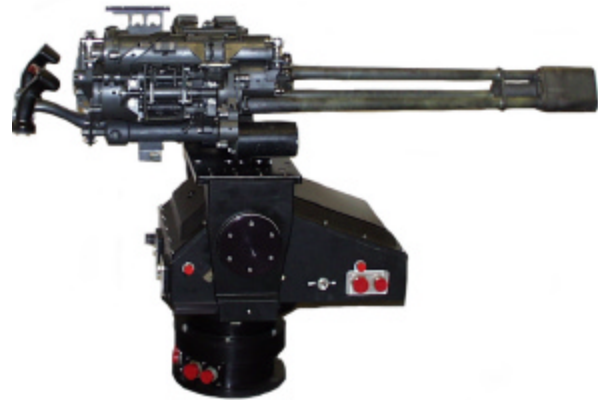


# Common Remotely Operated Weapon Station (CROWS)

## Summary

- CROWS:
  - provides the soldier with increased capability to acquire and engage targets
  - can be integrated onto a variety of vehicles
- Initial performance looks promising
- Testing continues to further define capabilities and identify areas for improvement

# Weapon Systems Improvement



- **Jim Ernest, Naval Surface Warfare Center**  
**Crane Division, *Senior Mechanical Engineer***  
**Phone: (812) 854-5776**  
**Email: Ernest\_J@crane.navy.mil**
- **Nigel Wasil, DynCorp, Crane Division,**  
***Computer Engineer Technician***  
**Phone: (812) 854-5940**  
**Email: Wasil\_N@crane.navy.mil**



# Weapons Systems Improvements

## **Background/Customers**

**MK98 Universal Gun Mount**

**Remote Operated Small Arms Mount (ROSAM)**

**Integrated Radar/Optical Sighting System (IROSS)**

**Integrated Bridge System (IBS)**

**Future Workload**

# Background

## **MK38 Machine Gun System**

**Navy Operational Requirement (1982)**

## **Special Warfare Conventional Mounts**

**Naval Special Warfare Command (1990's)**

## **MK V Special Operations Craft**

**Weapons Installations (1995)**

## **Weapons Enhancement Efforts**

**Office of Special Technology (1998)**

## **Remote Operated System Testing**

**US Special Operations Command (2000)**





# Supported Weapons

## WEAPON: GAU-17 GATLING GUN (Mini-Gun)

- CALIBER: 7.62MM
- WEIGHT: 40 LBS.
- RATE OF FIRE: 3000 RND/ MIN.
- EFFECTIVE RANGE: 1000 YARDS



## WEAPON: M240 MACHINE GUN

- CALIBER: 7.62MM
- WEIGHT: 26 LBS.
- RATE OF FIRE: 750-950 RND/ MIN.
- EFFECTIVE RANGE: 1000 YARDS



## WEAPON: GAU-16 MACHINE GUN

- CALIBER: .50
- WEIGHT: 61 LBS.
- RATE OF FIRE: 750-850 RND/ MIN.
- EFFECTIVE RANGE: 2000 YARDS



# Supported Weapons

Continued.....

## WEAPON: M2 MACHINE GUN

- CALIBER: .50
- WEIGHT: 82 LBS.
- RATE OF FIRE: 450-550 RND/MIN.
- EFFECTIVE RANGE: 2000 YARDS



## WEAPON: MK19 MACHINE GUN

- CALIBER: 40MM GRENADE
- WEIGHT: 77.6 LBS.
- RATE OF FIRE: 325-375 RND/MIN.
- EFFECTIVE RANGE: 1600 YARDS



## WEAPON: M60 MACHINE GUN

- CALIBER: 7.62MM
- WEIGHT: 23 LBS.
- RATE OF FIRE: 550 RND/MIN.
- EFFECTIVE RANGE: 1000 YARDS

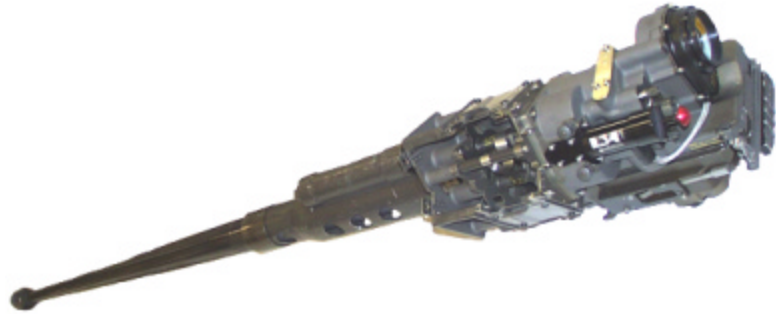


# Supported Weapons

Continued.....

## WEAPON: MK45 25MM AUTOMATIC GUN

- CALIBER: 25MM
- WEIGHT: 265 LBS.
- RATE OF FIRE: 400 RNDS/MIN.
- EFFECTIVE RANGE: 3000 YARDS



## WEAPON: MK44 30/40MM AUTOMATIC CANNON

- CALIBER: 30/40MM
- WEIGHT: 341 LBS.
- RATE OF FIRE: 200 RNDS/MIN.
- EFFECTIVE RANGE: 5600 YARDS



## WEAPON: M242 AUTOMATIC MACHINE GUN

- CALIBER: 25MM
- WEIGHT: 256 LBS.
- RATE OF FIRE: 175 RNDS/MIN.
- EFFECTIVE RANGE: 2700 YARDS



# Maritime Customers:

- Every US Navy Ship
- Every US Special Operations Command Craft
- Every US Coast Guard Cutter
- US Marine Corps (Riverine Craft)
- Joint Special Operation Command Craft
- Foreign Military Sales





# MK 98 Universal Gun Mount

**Background/Customers**

**MK98 Universal Gun Mount**

**Remote Operated Small Arms Mount (ROSAM)**

**Integrated Radar/Optical Sighting System (IROSS)**

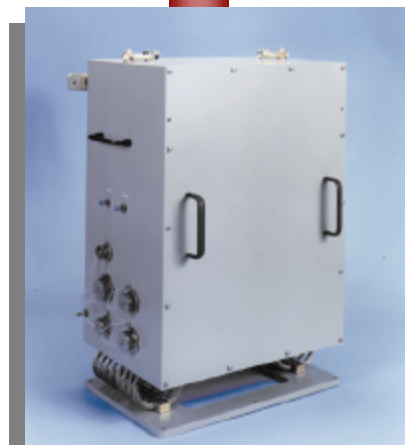
**Integrated Bridge System (IBS)**

**Future Workload**



## Features

- Utilizes the MK98 MOD 0 Universal Gun Mount
- System is Modular
- Drive / Stabilization Control is Digital with Auto Track (PC Based)
- Includes Sensor and Fire Control Options
- Configuration Options



# Configuration Options

## ■ Sensors

- Dual CCD Television Cameras (resident)
- Color CCD Television
- TWS or MFLIR (TIS)
- ESLRF
- Packaged Multi-Sensor (Remote Operated Small Arms Mount Integrated Bridge System – US SOCOM)

## ■ Fire Control

- Ballistic Look Up Tables (resident)
- AN/SPS-73 Radar
- Interfaces with MK86, MK160, or Flexible Fire Control System
- Direct Interfaces to MK46 MOD 1

## ■ Weapons

- |               |                             |
|---------------|-----------------------------|
| – 25mm        | M242 or MK45                |
| – .50 Caliber | Gatling (GAU-19) or twin M2 |
| – Missiles    | Stinger                     |
| – (30mm       | MK44 (with redesign))       |

## ■ Other

- Low RCS

# Basic System

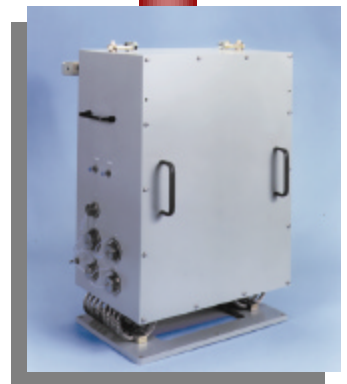
## ■ Features

- Bushmaster High Rate of Fire 25mm Chain Gun (dual feed) (MK45 MOD 0)
- 2-Axis Stabilization (gyro)
- Total Remote Control with manual range inputs for ballistics offset calculation
- Automatic Video Tracker
- PC Based Digital Design (gun processor)
- Boresight Adjust Provisions
- Interfaces with existing MK38 deck mount
- Utilizes ships power

## ■ Specifications

- Electronic Drive
  - 0.03° to 30° / sec Velocity
  - 60° / sec<sup>2</sup> Acceleration
- Stabilization
  - 400 microradians RMS
- Television / Dual FOV
  - Monochrome CCD (daylight)
- Power
  - 115 VAC / 60 Hz / 30 Amps (or 24 VDC)
- Weight
 

– Weapon Mount	762 kg (1680 lbs)
– Electronics Unit	136 kg (300 lbs)





# Mount

- **Control** Local (Manual) or Remote
- **Train**  $\pm 150^\circ$  Azimuth  
(with adjustable limit stops to  $\pm 180^\circ$ )  
 $+55^\circ$  Elevation  
 $-20^\circ$  Depression
- **Height** 137.2 cm (54 inches)
- **Working Circle** 460.0 cm (181 inches)
- **Deck Mount** 73.7 cm (29 inches)
- **Security** Azimuth and Elevation  
Manual Stow Locks
- **Ready Ammo (25mm)** 600 rounds / dual container
- **Ammo Reload Time** 4 minutes

# R.O.S.A.M.

## Remote Operated Small Arms Mount

**Background/Customers**

**MK98 Universal Gun Mount**

**Remote Operated Small Arms Mount (ROSAM)**

**Integrated Radar/Optical Sighting System (IROSS)**

**Integrated Bridge System (IBS)**

**Future Workload**



## Features

- **Surface Scanning Radar**
- **Remote Optical Sighting System**
- **Interface Module**
- **Hand Controller**
- **GPS, Digital Navigation Compass**
- **Autonomous Mount/Weapons**

# Protocols

- **NMEA 0183 RSD format**
  - (\$--RSD,x.x,x.x,x.x,x.....x.x,a,a\*<CR><LF>)
  - TLL similar
  - ARP processed data
- **Mount Protocol Data**
  - RS485 data
  - \$ 1V0010) **velocity command elevation**
  - \$ 2V0005) **velocity command azimuth**
- **Remote Optical Sighting Systems**
- **GPS, Digital Compass**
- **DNC NIMA Charts**
- **LAN TCP/IP protocol**
- **RS232 protocol commands**
- **Wireless communication devices**



## Optical Sighting Systems

- ARGOS Vision Systems
- FLIR Systems
- Wescam
- Boeing
- Kollmorgen

POP-200  
MARFLIR  
Model 14  
TISS  
MK 46 OSS



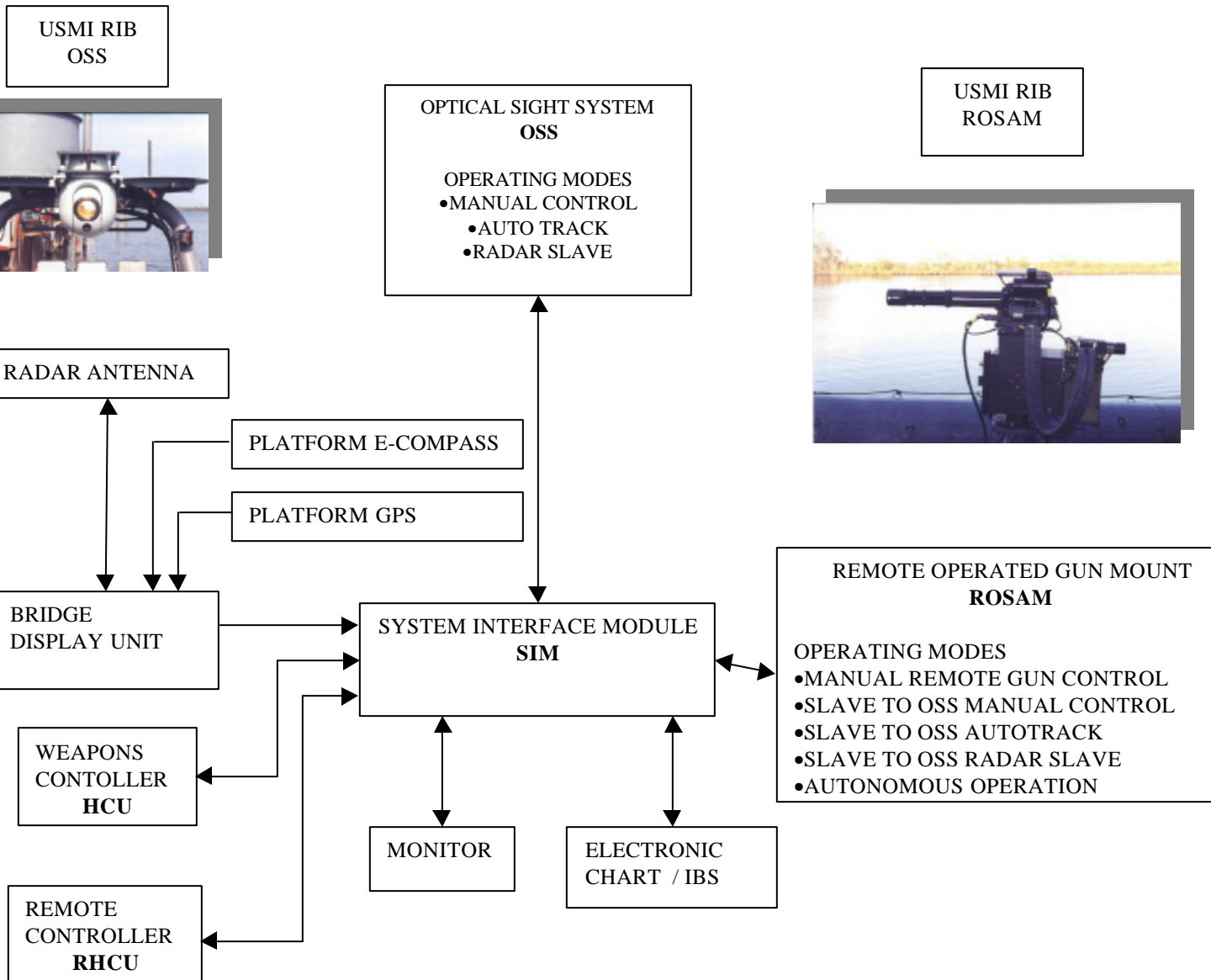
# Mount

- 60° Per Second Slew Rate
- 160 Pounds
- 600 lbs. Maximum Carrying Capacity
- 2-Axis Stabilization
- 24V  $\pm$  2 VDC, 25 AMP Fused
- RS485 Control Output Compatible
- 1 Milliradian Precision
- 60 Degree Tilt Range
- 360 Degree Azimuth Range
- Contrast/Edge Auto-Tracker
- On Mount FLIR/Camera
- Weapons: Twin M2HB, Single M2HB, MK19, MK44 7.62 Gatling Gun, Missiles



## Mode of Operation

- **Radar Identifies the Targets (NMEA 0183 Output)**
- **OSS (Optical Sighting System) Slaves to the Radar Bearing (\*If no OSS is used, the mounts sight is substituted\*)**
- **OSS Tracks the Target**
- **Mount Slaves to the Sight**
- **(Optional) Slave to GPS Location**
- **(Optional) Slave to Remote Radar Scan**



# Integrated Radar/Optical Sighting System (IROSS)

**Background/Customers**

**MK98 Universal Gun Mount**

**Remote Operated Small Arms Mount (ROSAM)**

**Integrated Radar/Optical Sighting System (IROSS)**

**Integrated Bridge System (IBS)**

**Future Workload**



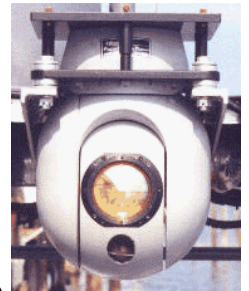
## Features

- **ROSAM Hardware**
- **Charting Overlays**
- **Picture-in-Picture Multi Viewing**
- **Multi Weapons Mount Integration**
- **One Workstation**

**Surface Scan  
Radar**

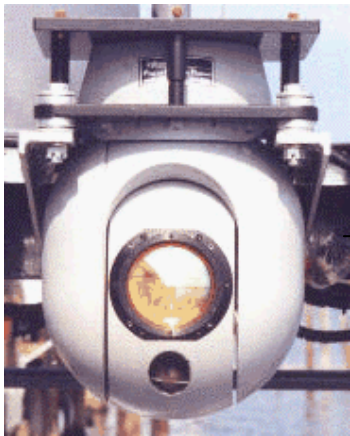


**Remote sensor**



**Integrated  
Common Operational Picture**

**Electro Optical Sensor**



**Remote Monitor**



**Controller**



**Weapon Mount**



**SIM**



# Integrated Bridge System

**Background/Customers**

**MK98 Universal Gun Mount**

**Remote Operated Small Arms Mount (ROSAM)**

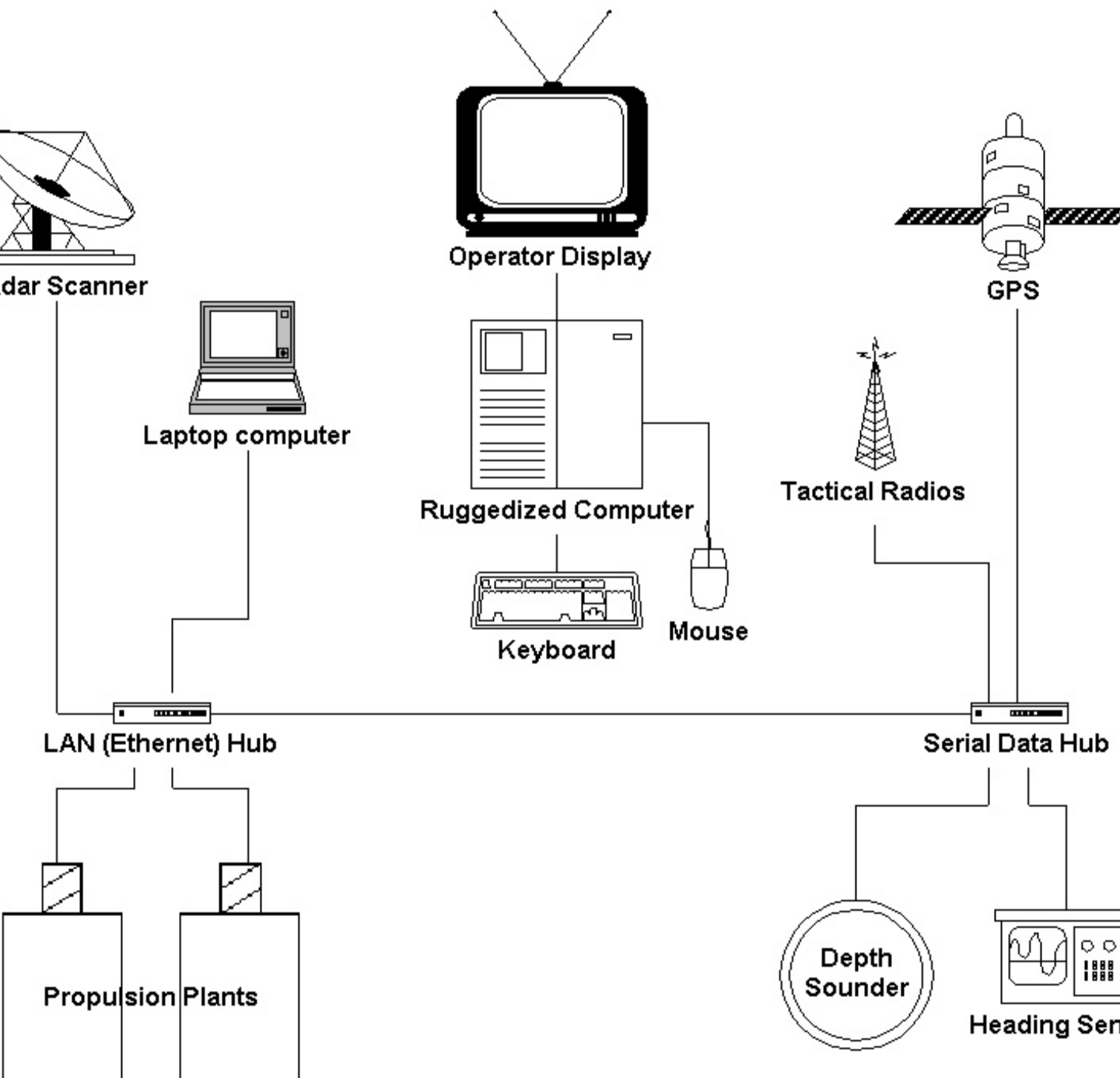
**Integrated Radar/Optical Sighting System (IROSS)**

**Integrated Bridge System (IBS)**

**Future Workload**

## Features

- **US SOCOM Operational Requirement**
- **Integration of Command and Control Functions**
  - **Radios, GPS, Video Consolidation**
  - **Navigation Charts**
  - **Engine Monitors**
  - **Weapons Control**
  - **Multiple Interchangeable Workstations**
- **Small Craft Compatible**
- **Daylight Screens**



# Integrated Bridge System



# Future Workload

**Background/Customers**

**MK98 Universal Gun Mount**

**Remote Operated Small Arms Mount (ROSAM)**

**Integrated Radar/Optical Sighting System (IROSS)**

**Integrated Bridge System (IBS)**

**Future Workload**

- **USSOCOM Weapons Control**
  - ◆ **Radar enhancement**
  - ◆ **Missiles**
  - ◆ **Multi Mount Control**
- **Training Platform Simulator**
- **ROSAM/IBS Block 3**
- **Remote target designation**
- **Remote Operation/Distance Support**
- **UAV/UWV Application**
- **IROSS Concept Demonstrator**

# Summary

## By The End of Next Fiscal Year

- **MK98 Stabilized Mount with Multiple Weapons Kits**
  - Twin M2HB's
  - Twin Stinger Missiles
  - M242 25MM Cannon
  - MK45 High Rate 25MM Cannon
  - Provisions for MK44 30MM Cannon
- **ROSAM Completion**
  - Multiple Radar
  - Multiple OSS
- **IROSS / IBS Integration**
  - MK98
  - ROSAM
  - Multiple Mounts
- **MWPS Trainer**